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Science Reporter



A CSIR
Publication

*A.P.J. Abdul
Kalam*

**National Icon,
International Humanist**

With inputs from:

- ▶ Prof. M.S. Swaminathan
- ▶ Prof. C.N.R. Rao
- ▶ Dr. K. Kasturirangan
- ▶ Dr. R.A. Mashelkar
- ▶ Shri R. Aravamudhan
- ▶ Dr. S. Ayyappan
- ▶ Dr. D. Balasubramanian

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- ▶ Wonders of Smiling
- ▶ Inflation & Multiverse
- ▶ Short Story
- ▶ Plus puzzles, quizzes, crossword & fiction



Science
Reporter



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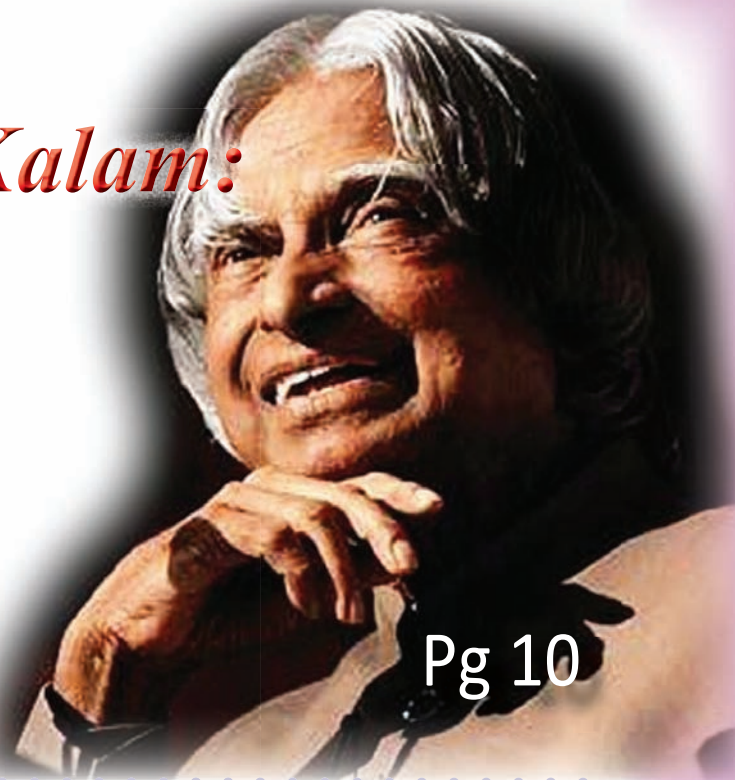
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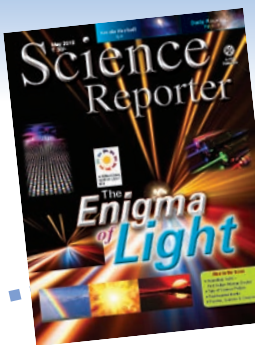


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Science Reporter



FASCINATING SPEED LIMIT

The feature article, **Decoding the Enigma Called Light** was vivid and informative. The authors have decoded the complex science of electromagnetic radiation in an easy language.

In this context, we may note that, light is the central cabinet for our Universe's



survival. It is one of nature's peculiar barriers that stops us from going beyond its limit. The speed of light (often denoted as " c ") is 299792458 m/s, which is the fastest rate of travel known to mankind, until now. It is something unique which inter-relates space and time.

Imagine an observer on the Earth who sees all celestial bodies, as they were in the past. In other words, he/she is looking back in time! Though this sounds crazy, but it's true. Similar communication lags are prominent in distant spacecraft orbiting planets like Jupiter or Pluto. The stars, galaxies and nebulae transform this lag into thousands to even billion years, which is indirectly helping the astronomers study the science of the origin of our cosmos.

The mystery of light is thus, baffling. It was just a mere four centuries ago, that we

made it into this adventure and have progressed immensely. Gourav Kumar Tanti Class IX, St. Xavier's School, Bardhaman

DECODING LIGHT

I was especially moved by the article in the May 2015 issue, **Decoding the Enigma called Light**.

I was especially happy to see the name of my favourite philosopher and mathematician René Descartes – the father of Modern



Philosophy! He geometrically explained the diagram of rainbow in "Discourse 8" of his Meteorology (Les Meteors). He also showed us the actions of light in his treatise Dioptrics (or Optics). There he discovered the fundamental law that the angle of incidence is equal to that of the angle of reflection.

When the news of Galileo's inquisition came, Descartes was at that time in Holland, writing his "Treatise on Light" in which he condemned the idea of an Earth-centred cosmos. When the news reached him, he immediately locked up his "Treatise on Light" inside the drawer. He wrote, "to live well you must live unseen"..... in the fear of the church! Descartes never published his "Treatise on Light". Fragments of it were

published after his death.

He combined Algebra with Geometry, discovered many laws in optics, made some great contributions to the laws of Motion, demonstrated the function of the human body, developed the idea of the capability of making infinite sets from finite, which is carried out by the human mind.

He died of pneumonia on way to Sweden at the age of 53!

Akhar Bandyopadhyay Class IX, Homeschool

FIREBALL IN KERALA SKY

The article **Fireball in Kerala Sky** was very interesting as it laid down several facts about fireballs and their occurrence. It would have been a great



opportunity for those who would have seen the glowing fireballs in the night sky.

Satyam Rout Angul, Odisha

PHASED BRIGHTNESS

Thanks to Dr. John Baruch for the thought-provoking article **Astronomy Opens the Door to the Universe of Rewarding Careers** (SR, June 2015). His inimitable style has provided a whiff of fresh air. Regarding Venus the author says that its

size (which appears in inverse proportion to its distance from the earth) and phase manage to keep its brightness to the same level. Concerning phase and brightness I would like to add a few words.

First, let us see how the phase of a planet (or its moon) is defined astronomically. The ratio of the visible illuminated part to the whole planetary disc is the phase P . For the mathematically-minded $P = \frac{1}{2}(1 + \cos d)$, where d is the angle SPE, S denotes the position of the sun, P the planet and E the earth. The phase can vary from 0 to 1, i.e., from invisibility to full. When less than half of the planetary disc is illuminated it is the crescent phase and more than half corresponds to the gibbous phase.

Next, we come to brightness, B . It varies as the phase and inversely as the square of the distance or $B = c(1 + \cos d)/p^2$. It can be easily seen that $\cos d = (p^2 + b^2 - a^2)/2pb$, where p is the distance between earth and the planet, between earth and sun the distance is a , and between sun and planet the distance is b . The first differential coefficient of B w.r.t. p should vanish for maximum value of B . With a little bit of mathematics it can be seen that for maximum brightness $p = (b^2 + 3a^2)^{1/2} - 2b$.

Dr. S. K. Gurtu Mansarovar, Jaipur

WE WOULD LIKE TO HEAR FROM YOU

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INDIA'S NATIONAL ICON IS NO MORE

Dr. A.P.J. Abdul Kalam, the eleventh President of India and the only scientist to occupy the chair, left the world just as he would have loved to. The 83-year-old scientist and technologist collapsed talking to students at the Indian Institute of Management in Shillong on 27 July 2015. And with his death the country lost a national and a youth icon the likes of which have been few and far between in modern India.

Dr. Kalam had taken upon himself the challenge to motivate and inspire as many children and youth he came into contact with. And, no doubt, with his nationalist ideals, his inspiring words and sage advice he endeared himself to the children and the youth of the country. His life-story is an inspiring journey.

Born on 15 October 1931 in Rameswaram in Tamil Nadu into a middle-class family, Kalam took up odd jobs in his childhood to support his family's meagre income. Yet, his is a truly inspiring story of dreaming to conquer the skies, which he did literally when he propelled India's space launch vehicle programme. His stint as the head of the Integrated Guided Missile Development Program (IGMDP) provided the country security with the impressive portfolio of missiles developed as part of the programme, which earned him the sobriquet 'missile man of India'. He believed that "unless India stands up to the world no one will respect us, strength respects strength".

Significantly, his life journey did not culminate when he became the eleventh President of the country. It seemed to have begun afresh, with a new mission. The journey to interact with the children and youth of the country, inspire them to achieve greatness with the strength of their moral character and the drive to take on challenges, and to dream big. He said "you have to dream before your dreams become true". But he believed that "dream is not what you see in sleep, dream is which does not let you sleep".

Dr. Kalam regarded children as the future precious resource of the country. He called upon educationists to build the capacities of the spirit of inquiry, creativity, entrepreneurial and moral leadership among students and become their role model. And he always motivated students to ask questions, to have courage to think differently, to travel the unexplored path, courage to discover the impossible and to conquer the problems and succeed.

A true national icon of modern India, Dr. A.P.J. Abdul Kalam would be missed by one and all.

Hasan Jawaid Khan

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M. S. SWAMINATHAN

"Dr. Kalam was an unusual human being full of love for fellow human beings and full of concern for the progress and development of India."

Dr. A.P.J. Abdul Kalam

A Scientist's Scientist

MY association with Dr. Kalam extends to nearly 40 years. Dr. Vikram Sarabhai first told me about him and said that he was an exceedingly capable, competent and concerned professional.

What impressed me with Dr. Kalam from our very first meeting was his determination that India should become a developed country. He didn't like India to be referred to as a developing nation struggling to feed itself. Like the great freedom poet, Subramania Bharati, Kalam wanted that no child, woman or man should go to bed hungry in our country. That was the reason for his interest in the green revolution and in my own work. When he was President of India he invariably mentioned in every lecture how the green revolution changed our destiny in the field of agriculture and food security.

To Dr. Kalam, religion, caste, language and other criteria that divide Indians and place them in pigeon holes were unacceptable. He was an Indian first and Indian last. Therefore, he wanted all parts of India to progress. The rural-urban divide in access to basic needs like

school, drinking water, electricity, roads, healthcare facilities, etc. was a matter of deep concern to him. This is why when he became President, he started advocating "PURA" (Provision of Urban Amenities in Rural Areas). He actively encouraged both government and non-governmental institutions to take to PURA. In fact when Gen. Musharraf, the then President of Pakistan, visited him in Rashtrapati Bhavan, he showed Musharraf on a computer screen the basic elements of PURA and advised him strongly that PURA should be taken up in Pakistan so that the people in rural areas are able to have access to the minimum needs of a human being.

I must also refer to the changes he brought about in Rashtrapati Bhavan. First of all, in the room where the President normally meets visitors, he installed a working table in a corner along with a computer. Whenever he wanted to make a point to an important visiting dignitary, like President Musharraf, he would take him to his working table and make a PowerPoint presentation.

Kalam was a great educationist. Spreading scientific literacy was his

passion. Therefore, he gave much importance to young scholars and children. He often used to say that today's children are tomorrow's citizens and therefore, we should pay considerable attention to both their education, physical health and their value systems. This was essential to generate the human resource needed for us to become a developed country.

Let me cite an example of his approach to students. In September 2003, Kalam came to Kottakkal in Kerala to inaugurate the Centre for Medicinal Plant Research of the Arya Vaidya Sala, which is the oldest and the most reputed Ayurveda Centre in the world. As usual, the security personnel had put several barricades to keep the audience away from the President. Students were asked to sit in one enclosure surrounded by a fence. Kalam noted it from his seat in the dais. As soon as the meeting was over, he stepped down from the dais and rushed towards the enclosure where the students were seated. He apologised to them for his inaccessibility due to reasons of security and distributed his visiting card containing his email address among



Left: Prof. Swaminathan paying his tributes to Dr. A.P.J. Abdul Kalam

To Dr. Kalam, religion, caste, language and other criteria that divide Indians and place them in pigeon holes were unacceptable.

students. He told them that any doubt they have, they should write to him and he will respond immediately. This was not just an empty promise, since I learnt subsequently from some of the students that he had replied to them and that they were very proud to have a letter from the President of India.

Let me cite another example of Kalam's concern for building up the self-esteem of the economically and socially underprivileged rural women. I had invited him to deliver the First Convocation of the Jamsetji Tata National Virtual Academy for Rural Prosperity (NVA) and he readily accepted when he came to know that the Academicians were all rural women and men who had studied only upto the 8th or 10th class. He attended the first convocation held at the National Academy of Agriculture Sciences building in New Delhi and was most impressed with their capacity and unrecognised ability. He mentioned in his address that the Academy represents "the Core Competence of Rural India". At the end of the Convocation he liberally gave time to sit for photographs with the rural women and men who had been elected as Fellows of NVA.

He then asked me where the next convocation was to be held. I mentioned that we planned to have it in Hyderabad in the campus of the Agriculture University. He immediately asked me, "Will you invite me again, for the next convocation?" I told him that it will be a great honour as well as a tribute to the rural academicians, if the President of

India would be the Chief Guest at two consecutive Convocations. This was the hallmark of his humility and modesty on the one hand and love for rural families on the other. He never stood on formality or protocol and he is therefore rightly referred to as the "People's President".

Being an outstanding scientist and the first scientist to receive the Bharat Ratna, Kalam placed emphasis on chronicling facts and events accurately. His various books including Igniting Minds are a testimony to his desire to record his observations and view point.

He also got several books prepared by eminent scientists on the flora and fauna of the Mughal Gardens of Rashtrapati Bhawan. When he was invited to inaugurate the CMPR at Kottakkal, he requested the Managing Trustee Dr. P. K. Warriar to help him in establishing a Medicinal Plant Garden in Rashtrapati Bhawan. He also established an Astral Garden. Not only did he establish such valuable gardens at Rashtrapati Bhawan, he also advised the Governors of States to establish similar gardens in their Raj Bhavans. I have seen a very good medicinal plant garden established at Raj Bhavan, Kolkatta by Shri Gopalkrishna Gandhi the then Governor of West Bengal. Thus, he launched a movement for the conservation and sustainable use of agrobiodiversity.

His work in the field of missile technology as well as his contributions to Pokhran II, jointly with the Department of Atomic Energy, are well known. Probably due to his enthusiasm for

science and technology, the then Prime minister, Shri Atal Bihari Vajpayee added a "Jai Vigyan" to Lal Bahadur Shastri's "Jai Jawan Jai Kisan". He used to make his own PowerPoint presentation and sometimes one could observe him sitting in the podium and quickly modifying some of his presentations according to the audience. The security personnel used to wonder what he was doing. Though a minute-to-minute programme was insisted upon by his Secretariat, he was always generous and gave more time to the organisers than what they had bargained for.

To sum up, Kalam was an unusual human being full of love for fellow human beings and full of concern for the progress and development of India in a secular, democratic and egalitarian manner. The best tribute we can pay him is to work for his vision of India as a developed country where there will be no one below the poverty line and where there will be no child malnourished or illiterate.

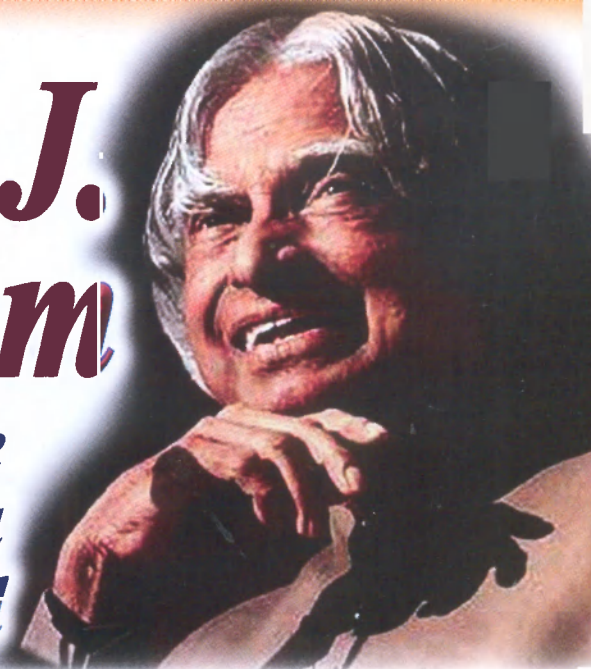


Prof. M. S. Swaminathan is widely renowned as the architect of the Indian Green Revolution that made India self-reliant in the field of agriculture. He has been honoured with the Padma Bhushan, Padma Vibhushan and Padma Shri. Prof. Swaminathan is also the Founder Chairman and Chief Mentor of the M S Swaminathan Research Foundation based in Chennai.

R. ARAVAMUDHAN

Dr. A.P.J. Abdul Kalam

From a Colleague and Friend to a National Legend



Dr. A.P.J. Abdul Kalam, former President of India, a great scientist and technologist, a teacher and a humanist passed away recently. Here's an account by the author of his association with the great man.

ABDUL Kalam was a few years older than me, but we joined the Indian Space Research Organisation (ISRO) around the same time in 1963. In fact, we met for the first time in the United States.

Strangely we had both graduated from the same institution, the Madras Institute of Technology, where my subject was electronics and his aeronautics, but in different years. After passing out I had joined the Department of Atomic Energy and he joined the Aeronautical Development Establishment of the Defence Research and Development Organisation (DRDO). Both of us were, however, selected by Dr. Vikram Sarabhai for training in NASA in the field of sounding rockets.

My area of training was in telemetry and tracking while Kalam's was in the area of rocket aerodynamics, range safety and assembly and launching of rockets. We were young and enthusiastic and quickly picked up the techniques of establishing and operating a sounding rocket launching station.

We were a group of about half a dozen engineers. Some of us had spent some time in the Goddard Space Flight Centre in Greenbelt, Maryland and finally were posted in the Wallops Launch Centre of NASA in Virginia.

We were given accommodation in the Bachelor Officers Quarters (BOQ) in the Centre and for some time Kalam and I were roommates. Both of us were vegetarians and had to survive on mashed potatoes, boiled beans, peas, bread and milk.

Life in Wallops was pretty lonely, but over weekends we were allowed to travel free of cost in the NASA shuttle plane which used to fly between Wallops and Washington DC. We could thus do our shopping in the Capital and go round and visit places of interest and watch movies and so on. We also got special concession in selected hotels being NASA employees.

We returned to India in December 1963 and moved immediately to Trivandrum, the capital of the southern state of Kerala. A few kilometers from here on the sands of the Arabian Sea was a place called Thumba where Vikram Sarabhai had decided to locate a sounding rocket launching station. The location was of immense scientific importance since it was on the earth's magnetic equator and there were a host of geophysical phenomena affecting earth's climate and the ionosphere which needed to be studied in situ from here.

Along with our colleagues we set about the task of establishing the launch station. Kalam was given the responsibility of assisting the experimental scientists in

building and integrating their payloads and mounting them on the rockets. I was responsible for setting up the telemetry and tracking systems.

Over the next few years Thumba became an internationally famous centre for sounding rocket research and was eventually dedicated to the United Nations in 1968 by the then Prime Minister Indira Gandhi.

Meanwhile, guided by the visionary Vikram Sarabhai, the Indian Space Research Organisation (ISRO) decided to develop satellites and satellite launch vehicles and Kalam was chosen to lead the Launch Vehicle development programme and was nominated the Project Director for the SLV project. This was in 1972 and saw Kalam and his project team working tirelessly to make the project a reality.

This was also when Kalam showed that he was a born leader and drove his team to work hard by himself working twice as hard. He was a bachelor and could spend long lengths of time at work to see the programmes through. He and his teams had to overcome many an obstacle to make progress in this complex technology where knowhow was not available for love or money from advanced countries in view of its strategic nature.

It took seven years to get ready for the first flight of SLV 3 and on 10 August 1979 the launch vehicle was erected o



Left: This picture taken around the mid-60s shows the author on the left (shirtless and with glasses) and Kalam squatting on the right working on a rocket payload



The author and his wife being shown round the Rashtrapati Bhavan by President Kalam

the pad for a launch attempt. Alas, the flight was a failure and there was utter disappointment all around! This was when the leadership qualities of Kalam came to the forefront and as he constantly used to say "Don't let the problems be your master, but use them as an opportunity to improve and become their master!"

The teams worked hard for almost one year and after carefully analyzing the masses of telemetry data collected from the failed flight, rectified the defective systems and were ready for the next flight. This time the flight was a great success and India entered into the select group of nations having a satellite launch vehicle capability.

ISRO built on this success and went on to bigger launch vehicle projects like ASLV, PSLV etc. The organization grew and started new branches to build various kinds of spacecraft and launch them from Indian soil. Space Technology became an important tool for national development.

Meanwhile, in 1982, Kalam had moved on from ISRO to a new but related area which was crucial to India's defence, that of missiles! He took over as the Director of the Defence Research and Development Laboratory (DRDL) at Hyderabad.

My interactions with him at this stage continued as I had taken over as the Director of the Sriharikota Launch Centre of ISRO north of Madras on the coast of the Bay of Bengal. At that point of time they made extensive use of our facilities for the development of missiles and we used to provide tracking and safety support to them. Our close friendship helped in cutting down formalities and accelerating progress.

Kalam's earlier stint of about two decades in ISRO helped him a lot in

drawing from the experience of his former colleagues and using it for the rapid development of a series of missiles for the countries' defence. In the subsequent years he was appointed as the Chief of DRDO and the Scientific Advisor to the Minister of Defence. I had also moved on from Sriharikota and had taken over as the Director of the ISRO Satellite Centre in Bangalore.

From this point on our interaction was sporadic and I watched him taking forward the DRDO from strength to strength. He was also duly recognized and honoured by both the scientific community and the political bosses. His final glory came when he spearheaded a team of nuclear and defence scientists to successfully conduct a peaceful nuclear explosion. He had been awarded many civilian honours earlier, but on this occasion he was awarded the Bharat Ratna, the highest civilian award one could be given in India!

By the year 2000, both of us had retired from our active professional life and in 2002 Kalam took to teaching in a big way. He had just settled in the Anna University in Chennai as a professor when rumours were afloat that he was being considered for the nation's highest post! Soon this was confirmed and he moved to Delhi and the rest is history!

As President, during his visits to ISRO, we occasionally met briefly and he used to talk about our good old days. He used to enquire about my family since he knew them well and had been a frequent visitor to our home in his ISRO days.

Towards the end of his tenure as President he invited me and my wife to spend a week in Rashtrapati Bhavan as his personal guest. We had a memorable stay with him and he spent quite a few evenings with us walking in the famous

Moghul Gardens and talking about the good old days in NASA and later in Trivandrum.

After he demitted office he used to call me occasionally to enquire about my family and had promised to visit our home for a meal when he was in Bangalore. Alas, this was never to be and he passed away as he always wanted to... in good health and on his feet doing what he loved most, inspiring youngsters.



Shri R. Aravamudhan graduated with honours in electronics from the Madras Institute of Technology in 1960 and was directly recruited into the Department of Atomic Energy. He was the first of Dr. Vikram Sarabhai's hand-picked engineers to join India's space programme even before it started. After his training in rocketry and ground support at NASA he was posted at Trivandrum in 1963. He was one among the pioneers who made the Thumba Equatorial Rocket Launching Station (TERLS) operational, eventually taking over as its Director. He played a key role in developing and building six civilian indigenous Tracking Radars which even today form the backbone of ISRO's Sriharikota launch facility. In his almost half a century of association with ISRO, Aravamudhan has served in various capacities including as the Director of Satish Dhawan Space Centre at Sriharikota and as the Director of the ISRO Satellite Centre in Bangalore. He was also responsible for initiating and overseeing Reliability and Quality Assurance Activities at the ISRO level.

Dr. A.P.J. Abdul Kalam

From a Personal Lens

RAGHUNATH MASHELKAR

THE outpouring by the entire nation on hearing the news that Dr. A.P.J. Abdul Kalam is no more has been absolutely overwhelming. Indeed it has been unprecedented. I myself was so overwhelmed that when I was interviewed by a television channel minutes after the news broke out I got choked as I started responding. My views about him have appeared in the media in a variety of forms, including in a two part series published by the news paper DNA. I am happy to share them with the readers of *Science Reporter*.

Dr. Kalam is being referred to as the Missile Man. I will leave aside the 'missile' part of it and write about the 'man' part of it, the 'human' part of it, especially as I saw him from my personal lens.

My first interaction with Dr. Kalam was when I was a member of the Scientific Advisory Committee to the Prime Minister Shri Rajiv Gandhi. This was in 1987-88. I was given the responsibility of putting together a draft of a perspective plan on the future of Indian Science & Technology. I needed to cover different dimensions of Indian science & technology, including those pertaining to Defence Research and Development. I was trying to get hold of Dr. Kalam, who was then the scientific advisor to our Defence Minister, but I was

unable to do so. Finally, we accidentally met at the airport and managed to sit together in the plane.

I still remember his profusely apologizing for being inaccessible, explaining to me at great length as to how busy he was with his several projects. He asked me what I was looking for. I explained. He set aside whatever work he was doing. He pulled out a piece of paper and wrote his thoughts on the subject with his own hand. This very first meeting touched me, because I saw a man who was simple, very humane and yet professional at the same time. I was to realize his other qualities as I met him on several occasions later.

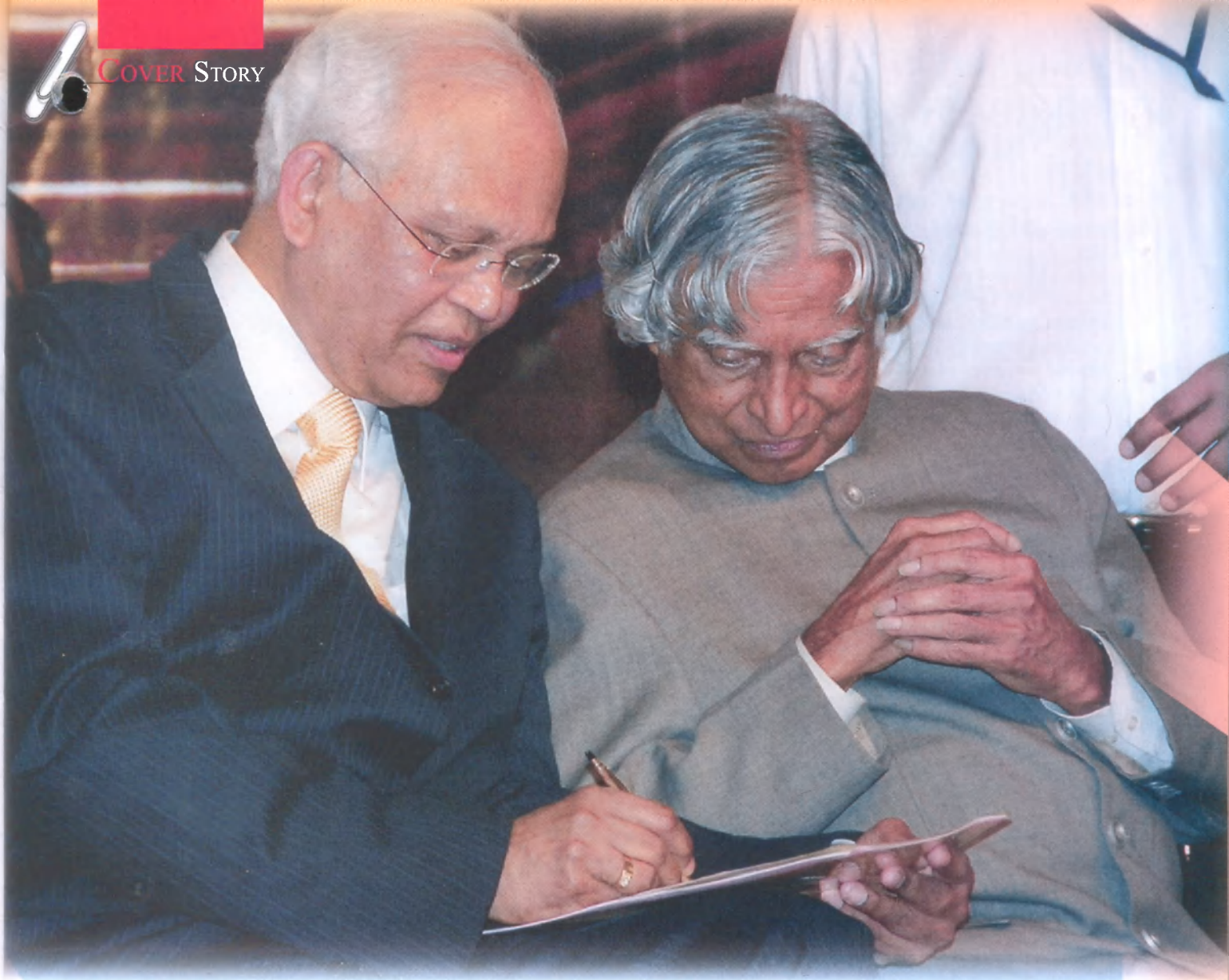
I saw evidence of his extraordinary humility and willingness to learn from others in another instance. I remember the year was 1992. I was then the Director of the CSIR-National Chemical Laboratory (NCL), Pune. I got a phone call from Dr. Kalam. He was then heading the Defence Research and Development Organization with a chain of more than 50 laboratories. Dr. Kalam told me that they were going to have a DRDO Director's conference in Pune and he wanted me to deliver the inaugural address. I happily accepted the invitation and asked Dr. Kalam as to what I should speak on.

India had just been liberalized in 1991, opening up its doors for trade with and investment from the rest of the

world. Dr. Kalam suggested that I should speak on 'fighting it into the market place in the post liberalized era'. He wanted me to talk about what Indian Science & Technology could do in this fight. I remember addressing the gathering, which was chaired by Dr. Kalam. While beginning the lecture, I addressed Dr. Kalam as 'Mr. Technology of India'. I went on to dwell on the theme of India's big challenge in the coming years as we opened up.

My penchant for patents was well known then. In 1989 itself, I had launched this 'movement on patent literacy' and put NCL on the path of becoming strong in patents, even licensing our patents to the advanced world. I referred to this issue of 'patent literacy' and said as to how this illiteracy had to be removed in order for India to face the stiff global competition.

After the lecture, there was a lunch. Dr. Kalam came to me and said, "Mashelkar, you have addressed me as 'Mr. Technology of India'. You also talked about patent literacy movement. But can I tell you that your 'Mr. Technology of India' is also 'Mr. Patent Illiterate' of India!" I asked him why he said that. He replied that he had little knowledge of patents, why they were important and what could his organization DRDO do. I explained. He immediately called someone and issued instructions to set



The only fitting tribute we can pay to Dr. Kalam is not only fulfilling his dream of Technology Vision 2020, but also setting up a game changing 'Vision 2050' in the true spirit of Dr Kalam, which always was to think and act with the belief that impossible can be made possible.

patent cells in each of the fifty plus DRDO laboratories. Today, DRDO has become not only aware of the patents but is also strong in patents. This simple instance shows on the one hand the humility of the great man, where he was prepared to admit what he did not know, and at the same time his acting so fast and decisively. Both these qualities are so crucial for leaders.

Today when I look at CSIR, we find that there is a major transformation in the CSIR chain of laboratories. All this transformation by CSIR was initially triggered due to a major initiative I took on the suggestion of Dr. Kalam. In fact, I vividly recollect the day was 1st of July 1995. This was the day when I took over

as the Director General, CSIR. We had a party in the evening to say farewell to Dr. S.K. Joshi, who had done such a wonderful job in steering CSIR in some really difficult times.

Dr. Kalam was also present in the party. He congratulated me and asked me, "Mashelkar, what is your vision for CSIR?" He went into deep details and told me how crucial it was for me as a new leader to formally launch a bold and clear vision statement, so that the entire CSIR family clearly understood what was in my mind. I remember finally making a presentation to the Advisory Board of CSIR, of which Dr. Kalam was also a member. I remember his many valuable contributions. This vision statement

'CSIR 2001: Vision & Strategy' became a major galvanising force and transformed CSIR. The organizational transformation progressed to such a level that in a book World Class in India written on the subject of managing the radical change, CSIR was the only institution to find a place along with the top organizations such as Reliance, WIPRO, Infosys, etc. who have managed the radical change best in the post-liberalized era in India. Professor Jayant Narlikar's book *Scientific Edge* also lists the CSIR transformation among the ten best achievements of Indian science and technology in the twentieth century. In some way, we at CSIR should be grateful to Dr. Kalam for providing that initial trigger!

Kalam was a Nationalist: Prof. C.N.R. Rao

An important aspect of Dr. Kalam was his interest in children. I share this with him. I give talks to children all over India on science. Last time that I met Kalam, he said why don't we together give a programme for children. Unfortunately, it did not happen. I share his positive attitude and nationalism. When I was in close touch with him in 1984-1990, he always talked of India becoming a great power.



Prof. C.N.R. Rao, F.R.S. is currently National Research Professor and Honorary President & Linus Pauling Research Professor Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore. He has been awarded the Padma Shri, Padma Vibhushan and the Bharat Ratna.

I found Dr. Kalam to be an extremely warm hearted and simple individual. I have personally experienced his warmth and affection. A very simple instance illustrates this. I remember Dr. Kalam phoning me one day at 11.00 A.M. in the morning when I was in my office. He said that he had fixed up a meeting of the Knowledge Task Force set up by the Prime Minister. He and I were then working together on the steering committee set up by the Chairman, Mr K.C. Pant, the then vice-chairman of the Planning Commission.

I said that I would be unable to join him because I had to leave by the 4.00 P.M. flight to Pune. I explained to him that only that morning I had received a call from Pune saying that my wife was suddenly taken very unwell. I desperately needed to be in Pune. I had dropped all my programmes and was flying back with the first available flight. I was so tense that I could not control myself and broke down on phone. Dr. Kalam consoled me. We ended the conversation. After 15 minutes, which, incidentally is the time it takes to come from Vigyan Bhavan to

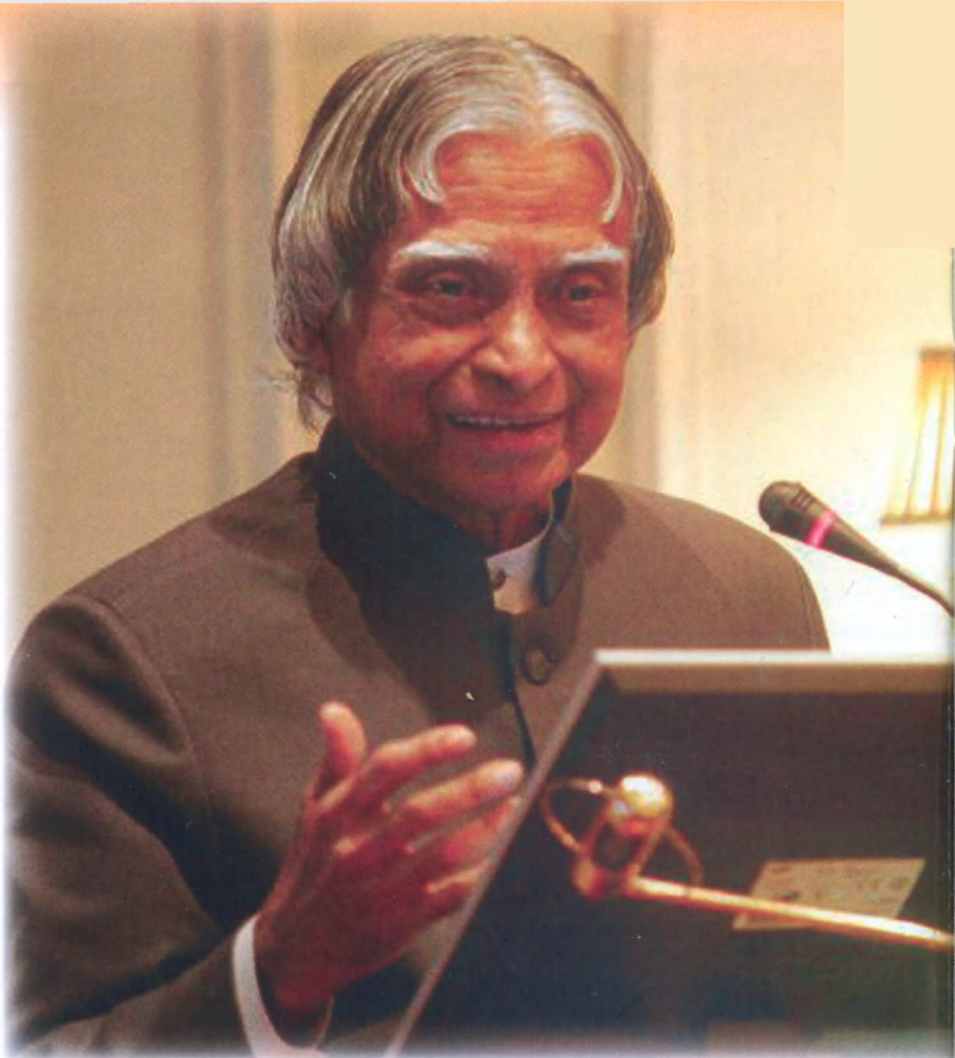
Anusandhan Bhavan, I was surprised to see that Dr. Kalam was there in my office, leaving a meeting that he was to chair! He spent an hour with me saying that we will get the best advice and help for her ailment from all possible sources from India and he will personally help. Not only that, he called me the following day to inquire about how she was and continued to do so. He came out as an extremely concerned and warm-hearted individual.

Dr. Kalam really caught the imagination of the children and the young, like few have done in India. This became evident when he came to Pune during the Indian Science Congress 2000 in January in Pune. I was then the President of the Science Congress. It was my dream to get the 'Trimurti' representing the leadership of space, defence and atomic energy together. That meant getting Dr. Kasturirangan, Dr. Chidambaram and Dr. Kalam on a single dais. I had asked them to project their dreams on creating a secure India. We had a memorable afternoon, where all these three great leaders gave their vision. I still remember

the events after the discussions. Dr. Kalam was mobbed by several hundred young people. I had to rescue him.

I had to perform the same act in Lucknow during the Indian Science Congress in 2002. There was a panel discussion going on. Dr. Murli Manohar Joshi, Dr. R. Chidambaram, Dr. Anil Kakodkar, Dr. Kasturirangan and myself were on the dais. There were around 2000 people in the audience. While the presentations were going on, Dr. Kalam walked in. Everyone forgot that we all were on the dais and rushed to Dr. Kalam! He was again surrounded by hundreds of young people. Dr. Murli Manohar Joshi told me to go down and rescue him. The only way out was to get him up on the dais so that we could continue. And indeed it was only then that we could resume the proceedings! I have never seen such an appeal of a scientist amongst the young, or indeed for that matter, amongst the society ever before.

Dr. Kalam was convinced that children were our future and we had to ignite their minds. When he was Principal Scientific Advisor to the Prime Minister



'After the lecture, there was a lunch. Dr. Kalam came to me and said, "Mashelkar, you have addressed me as 'Mr. Technology of India'. You also talked about patent literacy movement. But can I tell you that your 'Mr. Technology of India' is also 'Mr. Patent Illiterate' of India!"

I remember I had gone for a meeting with him. He was the chairman of the Committee to select the vice chancellor of Goa University and I was a member. After the meeting the conversation as usual drifted to talking about the future of India and how it will be built by our children. I still remember his telling me that in future he wanted to dedicate himself to the cause of igniting the minds of young children. He said that he would interact with at least 1,00,000 children in one year. He asked me, "Mashelkar, why don't you join me in this grand adventure. We two can go and inspire the children from a common platform." I remembered to have agreed to this enthusiastically but, of course, could not really join him.

Soon afterwards, Dr. Kalam became the President of India. I went to meet and congratulate him. The first thing he did was to remind me of this conversation. He asked me as to how many children I had addressed. He said that he had already addressed 50,000 children. I said I had addressed none, as I was so busy as DG, CSIR. He said that I must find time, no matter how busy I was and not only that I must address them, but also that he will exchange with me the number each one of us would have addressed each time we met. We followed this practice for two to three years, I remember!

In all our conversations, I found Dr Kalam to be deeply disturbed by the societal disconnects. Once he told me that his father and the high priest of Rameswaram temple could discuss Bhagavad Gita and Holy Quran in their houses. He mentioned several times as to how a church was transformed into a technology laboratory and became the birthplace of the nation's rocket technology. To him that was the result of the fusion of science and spirituality, and he wished that such fusion should happen in all fields in continuum.

I would like to end by repeating what Dr. Kalam said in this address to the nation on 25th July, when he was sworn in as President of India. He said:

"When I travel across our nation, when I hear the sound of waves of the three seas around the shores of my country, when I experience the breeze of wind from the mighty Himalayas, when I see the bio-diversity of North-East and our islands and when I feel the warmth from the western desert, I hear the voice of the youth: 'When can I sing the song of India?' If youth have to sing the song of India, India should become a developed country which is free from poverty, illiteracy and unemployment and is buoyant with economic prosperity, national security and internal harmony."

And then he went on to sing that song:

As a young citizen of India, armed with technology, knowledge and love for my nation, I realize, small aim is a crime.

I will work and sweat for a great vision, the vision of transforming India into a developed nation, powered by economic strength with value system.

I am one of the citizens of billion; only the vision will ignite the billion souls.

It has entered into me; the ignited soul compared to any resource is the most powerful resource on the earth, above the earth under the earth.

I will keep the lamp of knowledge burning to achieve the vision — Developed India.

"Soon afterwards, Dr. Kalam became the President of India. I went to meet and congratulate him. The first thing he did was to remind me of this conversation. He asked me as to how many children I had addressed. He said that he had already addressed 50,000 children".

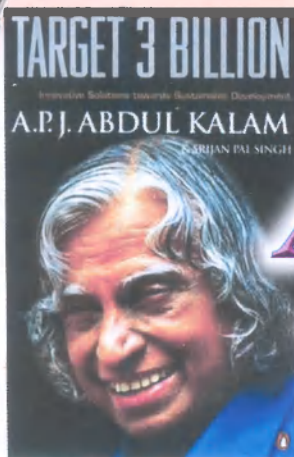
To me, in Dr. Kalam, we had a President, who was the right man, in the right place, at the right time. Indian youth were desperately looking for a role model. What better role model could they have had than someone who was the son of a boatman and went on to occupy the position of the President of India? What better role model could they have had than this simple and humane individual, who was a staunch nationalist, and who was a great dreamer and visionary at the same time? What better role model could they have had than an individual who strongly emphasised that 'strength respects strength' and wanted to see a Developed India in our life time.

The only fitting tribute we can pay to Dr. Kalam is not only fulfilling his dream of Technology Vision 2020, but also setting up a game changing 'Vision 2050' in the true spirit of Dr Kalam, which always was to think and act with the belief that impossible can be made possible.

This will only happen if each Indian in the true Kalam spirit said: "Yes, I can. Yes, India can. Yes, India will." We owe it to Dr. Kalam.



Dr. Raghunath Anant Mashelkar is an FRS, a chemical engineer, and the former Director-General of the Council of Scientific and Industrial Research (CSIR). He has also been honoured with the Padma Shri and the Padma Bhushan.



S. AYYAPPAN

APJ Abdul Kalam

Indian Scientist with Global Touch

Dr. A.P.J. Abdul Kalam, a complete human being who had the lifestyle of a common man, had dreams for the country that he translated into actions by motivating the Indian youth to enable India become a global leader.

Dr. Abdul Kalam was a compassionate professor who had ungrudging attitude for students vis-a-vis the country's development, as he quoted futuristically that 'students are the pillars of the nation'. Yes, Dr. Kalam dreamt of a young India – a strong India.

At the same time, Dr. Kalam's intent of 'farmers to have a long life' gave a call

for policies to be farmer-centric, and he always opined 'agriculture to play a key role not only for food security, but also for reducing poverty' in the country.

While remembering his unconditional service to the nation, I and the Indian Council of Agricultural Research also had opportunities to be with this distinguished scientist on several occasions – the World Conference on 'Animal Nutrition' on 16th February, 2009; Visit to Central Agricultural Research Institute (CARI), Port Blair on 3rd September 2009; 84th Foundation Day of ICAR in New Delhi on 16th July 2012 and the Golden Jubilee Celebrations of the Central Tuber Crops Research Institute (CTCRI) in Thiruvananthapuram on 28th January 2013.

While addressing the 84th Foundation Day of ICAR, Dr. Kalam appreciated the leadership role of the Council for 'Science-led Development' transforming the country into a self-sufficient nation. He envisioned 350 million tonnes of food by 2020 – the country today has achieved about 250 mt. I am sure with further concerted efforts and complementary policies, the target set by the great scientist would be achieved by enhancing the productivity of the bottom of the pyramid farmers. During brief discussions, I could feel his wisdom and determination for the country, no doubt Dr. Kalam was the 'People's President'.

We, in the Indian Council of Agricultural Research, pledge to realize the dreams of Dr. Kalam by meticulous efforts and systematic actions to translate agricultural science for societal development in letter and spirit. The



Dr. S. Ayyappan welcoming Dr. Kalam

ICAR family deeply mourns the sudden demise of Dr. A.P.J. Abdul Kalam, the 11th President of India. A scientist, teacher, philosopher and a true leader of India, Dr. Kalam would always be remembered for his endearing personality and his futuristic vision will always be in our minds.

May his great soul rest in peace, and continue inspiring the billions.

Jai Hind.



Dr. S. Ayyappan is the Secretary, Department of Agricultural Research and Education (DARE) & Director General, Indian Council of Agricultural Research (ICAR). A Fellow of the National Academy of Agricultural Sciences and the Society of Nature Conservators, Dr. Ayyappan has chaired numerous committees, working groups, and task forces in India's Ministry of Agriculture. This includes the Expert Committee for Development of Freshwater Aquaculture (2000-2001), the Working Group to formulate the Model Bill for Inland Fisheries and Aquaculture (2004), and the Task Force on Aquaculture and Marine Biotechnology (2006-2009).



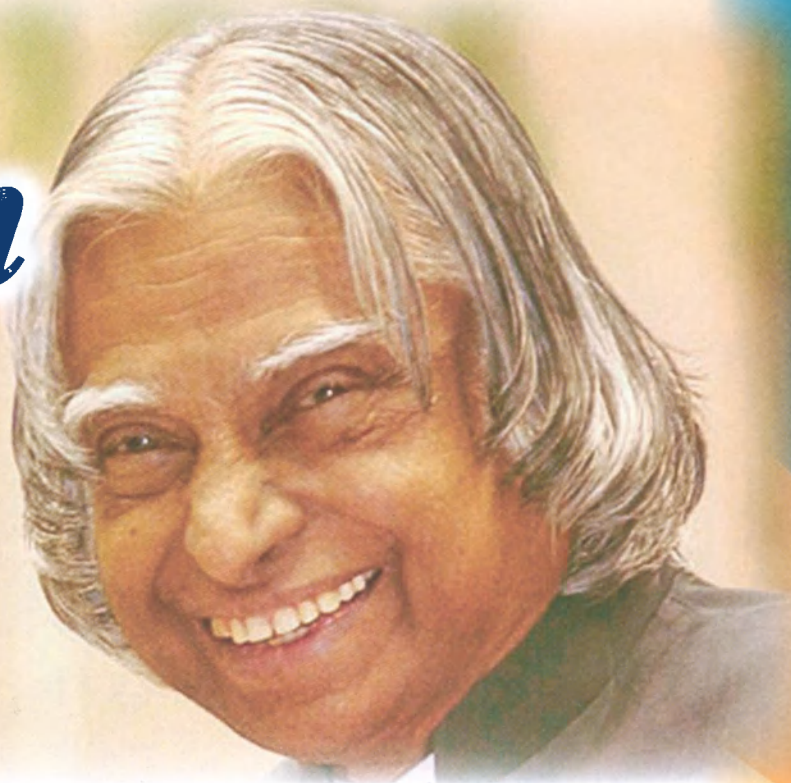
Dr. Abdul Kalam in CTCRI, Thiruvananthapuram sharing his valuable thoughts on the 'birth of a happy, prosperous and enlightened human life' with his unique style and infusing lots of energy in the gathering. He also exhorted the scientists to develop a plan for Island PURA (Providing Urban Amenities to Rural Areas) while visiting CARI, Port Blair.



Kalam

A Humane & Affectionate Nationalist

K. KASTURIRANGAN



I consider myself fortunate as I had known Dr. A.P.J. Abdul Kalam well over the years.

I first met him during my student days at the Physical Research Laboratory in Ahmedabad in the sixties. But it was only when I became chairman at the Indian Space Research Organization (ISRO) and he was head of DRDO, that we started meeting regularly. Whenever I came to Delhi, we would have dinner at Hotel Janpath and he always paid the bills.

When he became President, he once invited me to have dinner with him. Even though there were only the two of us, he made me sit at the head of the table. "You are my guest today, you are the most important person here," he said. After dinner he took me around the President's house and I could clearly see marks of his frugal and Spartan way of life even though he was the President of the country.

When I became a member of the Rajya Sabha, I went to the Rashtrapathi Bhavan to seek Dr. Kalam's blessings. He was very glad to note that I had become a nominated member, nominated by the then NDA Government and by Prime Minister Atal Bihari Vajpayeeji.

During our conversation, he was very particular about how I perform in the

august forum of the Indian parliament. He said I should never shirk my role of participating in important discussions where I could positively contribute. This was very well proved when I participated in the 123 Nuclear Deal discussions that took place in Rajya Sabha where I made my longest speech of 29 minutes. Nearly all the divergent political views represented by different parties appreciated my speech and the observations I made. The then Honourable Prime Minister Shri Manmohan Singh himself was very happy that he specifically expressed his appreciation.

Another point that Dr. Kalam made was that I should fully use the MP-LAD funds. Since I had the flexibility of giving the funds to any place within the country, I should be generous in supporting schools for children, hospitals and orphanages. Here too, I virtually fulfilled his suggestions.

Even at a deeper personal level, when I had invited Dr. Kalam for the marriage of my second son, he came all the way from Delhi to Trichy and spent nearly the whole of the morning mixing with my relatives and blessing my son and daughter-in-law.

Recently, when I went to meet him, he asked me for a copy of my report on the Western Ghats. But what amazed me

was that there was a crowd of students at his house. He was taking some classes for them. I could see his passion for teaching.

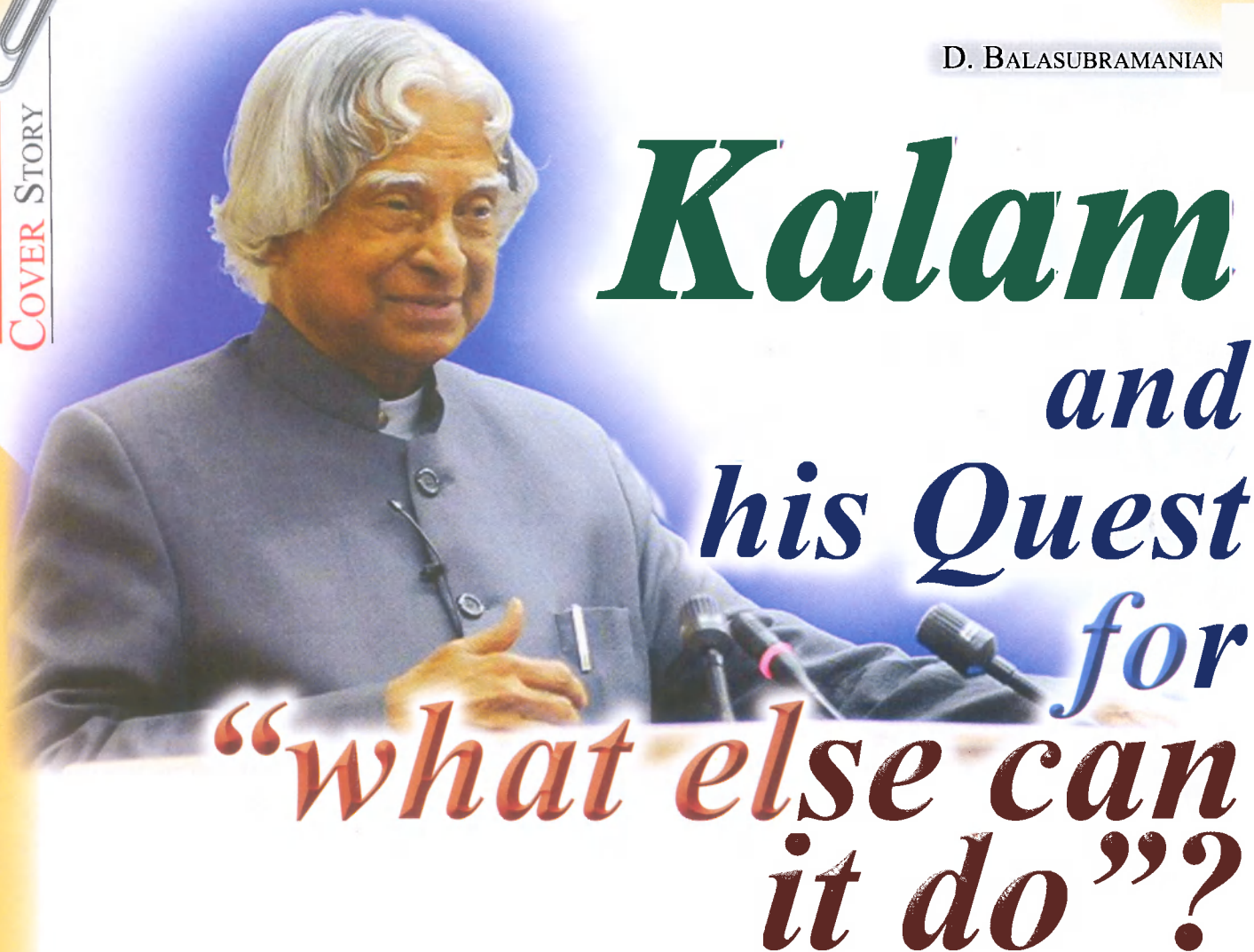
I can only say that he was a very humane, affectionate individual who worried about his colleagues and friends even as he wanted to do his best for the sake of our country.



Dr. Krishnaswamy Kasturirangan headed the Indian Space Research Organization (ISRO) from 1994 to 2003. He was a Member of the Rajya Sabha (2003-2009), Member of the Planning Commission of Government of India, Chancellor of Jawaharlal Nehru University and Chairman of the Karnataka Knowledge Commission. He was also the Director of the National Institute of Advanced Studies, Bangalore, from April 2004 to 2009. He is a recipient of the Padma Shri (1982), Padma Bhushan (1992) and Padma Vibhushan (2000).



D. BALASUBRAMANIAN



Kalam *and* *his Quest* *for* *“what else can* *it do”?*

THE late Avul Pakir Jainulabdeen Abdul Kalam has been described as a career scientist turned reluctant politician. Indeed so, since even as a President we knew him as one who, besides his Presidential duties, engaged with the public at large for development of the nation and development of the mind. For example, he asked what else can technological developments do, and came out with a detailed plan on what he called the provision of urban amenities in rural areas or PURA.

If PURA were to be extended across the country, many of us would rather live and work in such PURA villages than in clustered, polluted, so-called “smart cities”. He worked not just for the present but for the future; hence his interaction

with also about a million children, the builders of tomorrow.

At the core, he was a patriot, one who cared for the nation and its people. He constantly worried about how technology could help the common man, the disabled, and the disadvantaged. Even as he was involved in applying technology to produce tools and devices for national defense, he asked “what else can they do” for the community at large. His interest and contributions in the health sector are exemplified through a few examples.

When he realized that a coronary stent (a small extendable tube inserted in order to help smooth blood flow in heart patients) cost over Rs 60,000, he decided to make a prototype, using the safe, biocompatible and long-lasting stent from the alloys used in missile technology. Working with Dr. Somaraju,

this Kalam-Raju stent proved to be a low cost, safe and effective stent, and is now used in several hundred patients with success. Similarly, noting that the calipers that polio-affected individuals use for locomotion are not only heavy but expensive, he devised (along with Dr. Narendra Nath of Hyderabad) a far lighter one, made of a composite material used to make the nose cone of the Agni missile.

What is not so well known was his interest in biological and clinical sciences. Watching cancer-afflicted soldiers in army hospitals, he noticed that the family members who were giving care to the patients were not only worried but often prone to infection, illness and other physiological conditions. He wondered and asked some of us about this possible ‘mind-body’ connection and whether w



An engineering college student at Srujana explaining his eye-related innovation to Dr. Kalam

could conduct any biochemical analysis towards this.

My colleague Dr. Ashok Khar and I (at that time at CCMB in Hyderabad) agreed to work on this problem along with Dr. Kalam. He involved the army hospitals to provide blood samples of the care givers of cancer patients. We analyzed the immunological status of these people by assaying the levels of immunoglobulins, chosen molecules known to alter the levels of antibodies, and other related molecules. We analyzed over 80 samples, compared them with 'normal' controls, and found small differences between the two sets of people. While this was in accord with Kalam's suspicion about how the worried mind can affect the physiology of the care giver, we definitely need many more samples, in order to validate the results in a statistically acceptable manner. I hear that this project is still on at some defense hospitals and labs of the DRDO, so as to validate the prescience of Dr. Kalam.

Dr. Kalam's interest in eye health is well known. His interactions with Aravind Eye Hospital at Madurai, Sankara Nethralaya at Chennai and our own L V Prasad Eye Institute (LVPEI) at Hyderabad are well known. He once put together a novel type of laser unit meant for ophthalmic use and my colleague Dr. T.P. Das tested it out. Dr. Kalam inaugurated the LVPEI Institute campus at Bhubaneswar, and also our Innovation Centre, named Srujana (creativity) at Hyderabad.

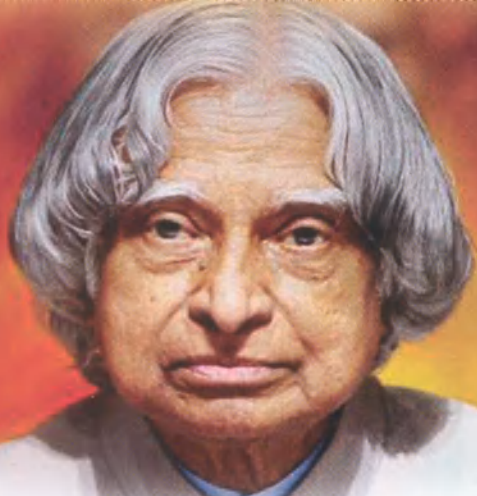
The other passion of Dr Kalam was music and poetry. He believed that music is the soul of a man's personality and practiced music. Dr. E. Bhagirath Rao (then at DRDO) writes about how Dr. Kalam pestered him to help learn the great Thyagaraja's Pancharatna Kriti: "Endaro Mahanu Bhavulu". Dr. Kalam not only learnt it, but soon after he was sworn in as President, he played it on the Veena (the words mean "Great souls are indeed many, and my salutations to them all", so characteristic of his humility

and admiration of scholars, and his predecessors as Presidents).

(This article appeared in *The Hindu* on 17 August 2015)



Dr. D. Balasubramanian is currently Director of Research at the L.V. Prasad Eye Institute at Hyderabad. He was earlier Director of the CSIR-Centre for Cellular and Molecular Biology (CSIR-CCMB). Dr. Balasubramanian has been awarded Padma Shri, INSA's Indira Gandhi Prize for Popularization of Science, UNESCO's Kalinga Prize for the Popularization of Science, and the Shanti Swarup Bhatnagar Prize. Email: dbala@lvpei.org



Dr. A.P.J. Chronicles of a

Late Dr. A.P.J. Abdul Kalam was the 11th President of India (2002-2007), and the first scientist and bachelor to occupy the seat of the Rashtrapati Bhavan. We bring together a string of incidences and photographs culled from various sources to try and sketch the life of this great human being who left an indelible imprint on the minds of millions the world over

(Compiled by Ms Kirti Bansal)



Kalam's house in Rameswaram

(<http://colorlibrary.blogspot.in/2012/09/a-p-j-abdul-kalam-rare-photos-from.html>)

Kalam was born on 15 October 1931 in a middle-class family in the town of Rameswaram in Tamil Nadu. He came from a family whose financial conditions weren't sound enough. As a means to support his family's meagre income, Kalam took up odd jobs in his childhood but never gave up on his education.

Student Kalam (<http://biography-of.com/abdul-kalam>)

Bottom right: Ramanathapuram Schwartz Matriculation School, the school of Abdul Kalam (<http://colorlibrary.blogspot.in/2012/09/a-p-j-abdul-kalam-rare-photos-from.html>)



KALAM'S LOVE OF FLYING

Kalam's primary school teacher Shri Siva Subramania Iyer in Rameswaram ignited his interest in the science behind flying. One day, when he was 10 years old and in class V, the topic of discussion in the class was 'how birds fly'. Mr. Iyer drew a diagram of a bird with a tail, wings and the body structure with a head on the blackboard. He explained the class how the birds create the lift and fly. Mr. Iyer then took the whole class to the Rameswaram seashore where dozens of seabirds were flying and said, "Look how the birds are flapping their wings to generate the lift... the same principles make an aircraft fly." (www.abdulkalam.com)



Abdul Kalam

Scientist and a Humanist

St. JOSEPH'S COLLEGE, TIRUCHIRAPALLI

B.Sc. (PHYSICS) 1952-54



http://www.indiavision2020.org/Kalam/kalam_journey.html

After school, Kalam went on to attend Saint Joseph's College, Tiruchirappalli, from where he graduated in physics in 1954.

IMPOSSIBLE...?

When he was a student of aeronautics at the Madras Institute of Technology, his professor Srinivasan placed him in a team of four students. The goal was to design a low-level attack aircraft. Kalam was to come up with the aerodynamic design. When Professor Srinivasan saw the design, he said, "This is just not good enough, Kalam. This is dismal work and I am disappointed that someone with your talent has come up with work like this." Not only was Kalam supposed to do the work again, he had to finish it in three days. The Professor said, "If you are unable to do so, your scholarship will be stopped."

Kalam worked very hard and just as he was putting the final touches to it, Professor came into the room, looked at his work and hugged Kalam affectionately. He said, "I knew I was putting you under immense pressure and set an impossible deadline—yet you have met it with work that I can only call outstanding. As your teacher, I had to push you to your limits so that you could recognise your own true potential."

Kalam said I learnt two lessons that day – a teacher who has his or her student's progress in mind is the best possible friend, because the teacher knows how to make sure that you excel. And second, there is no such thing as an impossible deadline. (Courtesy: www.outlookindia.com)



<https://www.vidyarthiplus.com/vp/attachment.php?aid=1682>



PILOT KALAM

Kalam wanted to become a fighter pilot after he specialised in aeronautical engineering from Madras Institute of Technology (MIT). He got two interview calls. One was from the Indian Air Force in Dehradun and another from the Directorate of Technical Development and Production (DTDP) at the Ministry of Defence in Delhi. While the interview at DTDP was "easy" he recounted that for the Air Force Selection Board, he realised that along with qualifications and engineering knowledge, they were also looking for a certain kind of "smartness" in the candidate. Mr. Kalam bagged the ninth position out of 25 candidates and was not recruited as only eight places were available.

Eventually, in 2006, when he was the President of the country, his desire was fulfilled when he flew in the cockpit of a fighter plane.

FAILURE AND SUCCESS

SLV-3 was India's first indigeneous satellite launch vehicle launched by Indian Space Research Organisation (ISRO) on 18 July 1980. When Dr. Kalam was the project director of India's Satellite Launch Vehicle (SLV-3) program, the whole rocket system plunged into the Bay of Bengal instead of the satellite going into orbit.

The Chairman of ISRO, Prof. Satish Dhawan, called a press conference and rather than thrust Kalam forward he took the entire responsibility for the failure. He said, "I'm confident that in exactly a year's time we can successfully place a satellite in orbit."

The next year, in July 1980, ISRO successfully launched a satellite. Again, there was a press conference but Prof. Dhawan asked Dr. Kalam to conduct the press conference. It was the greatness of Prof. Dhawan that helped keep up the morale of Kalam who later went to make the nation proud.

Dr. Kalam speaking at a SLV - III Review meeting at ISRO
(<http://colorlibrary.blogspot.in/2012/09/a-p-j-abdul-kalam-rare-photos-from.html>)

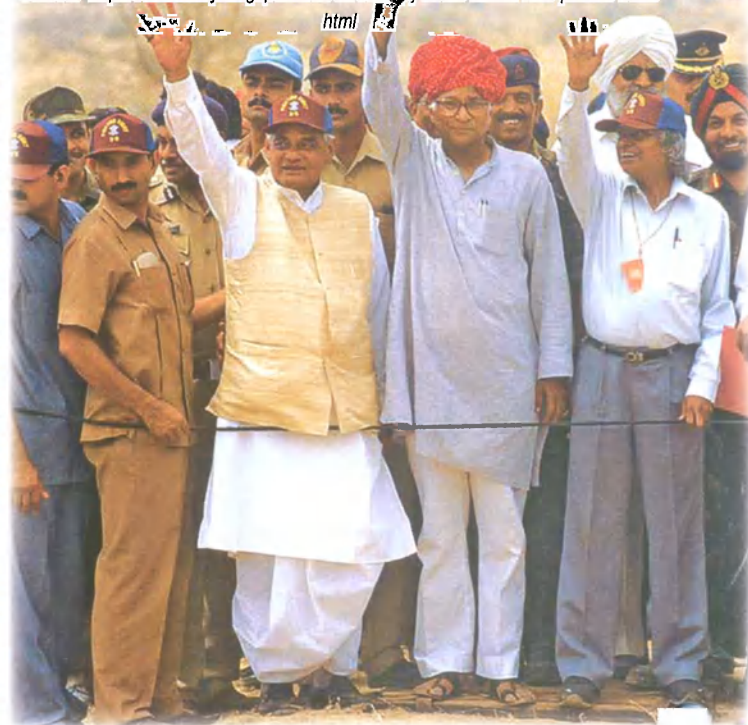


MAJOR GENERAL PRITHVIRAJ

Major General Prithviraj was the code name of Dr. Abdul Kalam for the operation "Shakti" in 1998. "Shakti" was the code name for India's nuclear tests to escape US spy satellites and spooks tasked with monitoring India's nuclear programme. Dr. Kalam took the name of 'Prithviraj' as an ironic twist to the fact that it was Dr. Kalam who started and developed the Prithvi ballistic missile, which is India's first nuclear capable missile programme.

The then Prime Minister Vajpayee and Kalam at Pokhran Nuclear test site

Source: <http://colorlibrary.blogspot.in/2012/09/a-p-j-abdul-kalam-rare-photos-from.html>



Dr. A.P.J. Abdul Kalam became the eleventh President of the country. Here is seen addressing the nation on the eve of Independence Day on 14 August 2005. (<http://pib.nic.in/drkalam/photo%20feature.htm>)



Dr. APJ Abdul Kalam receiving the Bharat Ratna Award

<http://colorlibrary.blogspot.in/2012/09/a-p-j-abdul-kalam-rare-photos-from.html>



INDIGENOUS CHALLENGES

Dr. Kalam along with cardiologist Dr. B. Soma Raju developed India's first low-cost coronary stent, later known as the "Kalam-Raju" stent. Importing the stents made them very costly. So Kalam took up the challenge to develop the stents indigenously. While DRDO provided the high-grade steel used in missiles, Dr. Raju's team designed the stent and carried out tests. Five years later, the Kalam-Raju stent was available at Rs 10,000 while the imported one cost Rs 75,000.

In 2012, the duo once again designed a rugged tablet computer for healthcare in rural areas, which was named the 'Kalam-Raju tablet'.

Another outcome of Kalam's vision was the lightweight caliper for polio patients. These were made up of glass-filled polypropylene, the same composite material used to manufacture the nose cone of the Agni missile. This led to the development of calipers that weigh as less as 400 g instead of the earlier 4 kg and were available at just Rs. 500 rather than Rs. 3500 at that time.

Politics & Government > Civic Participation > Reference Question



What should we do to free our planet from terrorism?

Dr APJ Abdul Kalam · 7 years ago

last updated 20 hrs ago

Human society, from onan until now, has always been at war within and between groups and has led to two World Wars. Presently, terrorism and low intensity warfare are affecting many parts of the world.

As the current global population of 6 billion increases to 8 billion by 2025, national and international conflicts will continue to be a source of concern for humanity. When evil minds combine, good minds have to work together and combat. In this context, what are the out-of-the-box solutions to free the planet earth from terrorism? Your answers when processed and implemented can lead to a peaceful, happy and safe planet earth.

YAHOO! ANSWERS staff notice: You can also view the President's video here: <http://in.promos.yahoo.com/valp/>. Register there to also win really cool prizes! Only Indian residents will be eligible for the prizes. Winners will be contacted on their yahoo email ids, so keep checking.

This is really the President of India, Dr. APJ Abdul Kalam. Keep checking our blog for more on this and the winners.
<http://blog.360.yahoo.com/blog-4e5Q5aMoRKY7EFGV5qQq52GFXY7cimb?pa=1898>

*"What should we do to free our planet from terrorism?"
This was the question that he asked on Yahoo answers
in 2007 and received more than 30,000 answers.*



Former President of India, Late Dr. A.P.J Abdul Kalam with the students of IIM Shillong (Picture courtesy: Facebook page of IIM Shillong)

KALAM – THE MOTIVATOR



<http://www.youthconnect.in>

Dr. A.P.J. Abdul Kalam loved the company of children. He believed that the youth had fewer biases about their society as compared to the grown-ups and hence it was much easier to motivate them. And since he never 'talked over' with the youth but always 'talked with' them, he was one person who would be mobbed by children wherever he went.

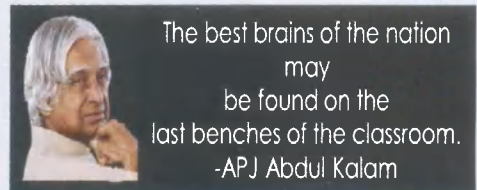
He called upon educationists to build the capacities of the spirit of inquiry, creativity, entrepreneurial and moral leadership among students and become their role model. And he always motivated students to ask questions.

Soon after becoming President in 2002, he visited a modest school to deliver a speech. When he was about to start his speech, the electricity suddenly went off. He walked right into the middle of the crowd and then spoke to 400 students with his bare voice and delivered, like always, an inspiring keynote.

Similarly, when Dr. Kalam was the chief guest at an event at IIM Ahmedabad, each student wanted a photograph with the former president. Dr. Kalam wouldn't leave the place until every person who wanted a picture with him got a picture.



<http://pib.nic.in/drkalamb/photo%20feature.htm>



The best brains of the nation
may
be found on the
last benches of the classroom.
-APJ Abdul Kalam



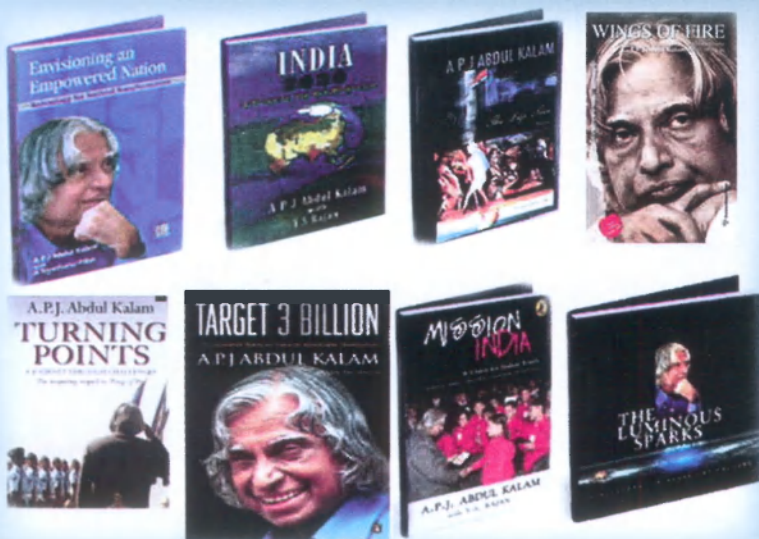
Photo: <http://www.jugades.com>, <http://www.thebetterindia.com>



Photo: idiva.com, <http://www.thebetterindia.com>

KALAM – THE WRITER

1. Developments in Fluid Mechanics and Space Technology, 1988
2. India 2020: A Vision for the New Millennium, 1988
3. Wings of Fire: An Autobiography, 1999
4. Ignited Minds: Unleashing the Power Within India, 2002
5. The Luminous Sparks, 2004
6. Mission India, 2005
7. Inspiring Thoughts, 2007
8. Target 3 Billion, 2011
9. You Are Born To Blossom: Take My Journey Beyond, 2011
10. Turning Points: A Journey Through Challenges, 2012
11. My Journey: Transforming Dreams into Actions, 2013
12. Forge Your Future: Candid, Forthright, Inspiring, 2014
13. A Manifesto for Change: A Sequel to India 2020, 2014
14. Transcendence My Spiritual Experiences with Pramukh Swamiji, 2015
15. Reignited: Scientific Pathways to a Brighter Future, 2015



MISSILE MAN OF INDIA

During his tenure in DRDO, Dr. Kalam headed the Integrated Guided Missile Development Program (IGMDP) and developed five missiles – Nag, Akash, Trishul, Agni and Prithvi. He was also responsible for the operation and development of Prithvi and Agni missiles and for designing indigenous weapons by bringing together various institutions.

As the Scientific Advisor to the Ministry of Defence and the Secretary to the Department of Defence Research and Development, he envisioned the concept of joint partnership which led to the formation of BrahMos Aerospace between Russia and India. BrahMos is the world's fastest cruise missile in operation.

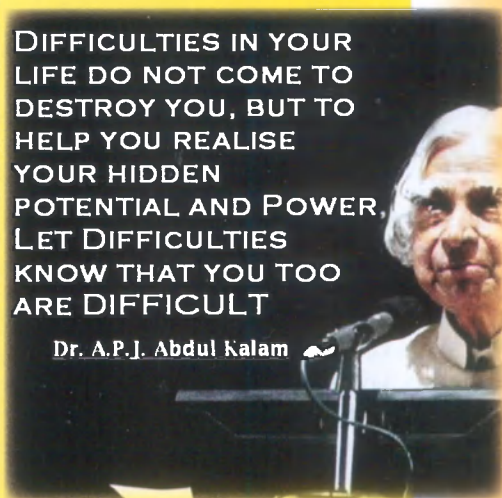
His contribution to the ballistic missile and launch vehicle technology earned him the sobriquet "Missile Man of India".

KALAM QUOTES

1. *It is very easy to defeat someone, but it is very hard to win someone.*
2. *We are all born with a divine fire in us. Our efforts should be to give wings to this fire and fill the world with the glow of its goodness.*
3. *Thinking is the capital, enterprise is the way, and hard work is the solution.*
4. *All birds find shelter during rain. But eagle avoids rain by flying above the clouds. Problems are common but attitude makes the difference.*
5. *Your best teacher is your last mistake.*
6. *Learning gives creativity, Creativity leads to thinking, Thinking provides knowledge, Knowledge makes you great.*

DIFFICULTIES IN YOUR LIFE DO NOT COME TO DESTROY YOU, BUT TO HELP YOU REALISE YOUR HIDDEN POTENTIAL AND POWER. LET DIFFICULTIES KNOW THAT YOU TOO ARE DIFFICULT

Dr. A.P.J. Abdul Kalam



NO FEAR OF DEATH

Kalam had a brush with death 14 years ago. On 30 September 2001 Kalam boarded a helicopter from Ranchi on way to Bokaro where he had to attend a school function. The pilots informed mid-air that there was something terribly wrong with the helicopter's rotor – it sounded like imminent death. Kalam remained composed with his signature smile playing on his lips. As the pilots tried to land the helicopter at Bokaro airstrip, they lost control and the helicopter crash-landed. Kalam sustained injuries and sprain in his body after the fall but drove straight from the crash site to the Ramakrishna Vidyalyaya in Bokaro to address the students as per the schedule.

DEFINITION OF KNOWLEDGE BY DR. APJ ABDUL KALAM

Knowledge = Creativity
+ Righteousness
+ Courage.

Creativity

Learning gives creativity
Creativity leads to thinking
Thinking provides knowledge
Knowledge makes you great

Righteousness

Where there is righteousness in the heart
There is beauty in the character.
When there is beauty in the character,
there is harmony in the home.
When there is harmony in the home,
There is an order in the nation.
When there is order in the nation,
There is peace in the world.

Courage

Courage to think different,
Courage to invent,
Courage to travel into an unexplored path,
Courage to discover the impossible,
Courage to combat the problems and succeed,
are the unique qualities of the youth.

KALAM – THE HUMANIST

1. When Dr Kalam was with the DRDO, he rejected the suggestion to put broken glass on the wall of a building that needed protection as birds would not be able to perch on the wall.
2. On the convocation day of IIT-Varanasi, Dr. Kalam, the chief guest, refused to sit on a chair that was designated for him because the chair was larger in size than the other chairs.
3. Dr. Kalam invited a road side cobbler and owner of a very small hotel as the Presidential guests to Kerala's Raj Bhavan during his first visit to Kerala after becoming the President.



<http://creofire.com/a-man-a-magnet-a-mission-apj-abdul-kalam/>

4. Once a subordinate of Dr. Kalam at DRDO couldn't take his children to an exhibition due to work pressure. Kalam surprised his subordinate and took the children instead.
5. He enjoyed writing Tamil poetry and playing the veenai, a South Indian string instrument and was deeply interested in Carnatic music.
6. By birth Abdul Kalam had one half ear. So, he used to cover one ear with his hair.

POETIC TRIBUTE

*Rest in peace o scientific Indian,
O guiding soul of hundred million,
Into the lap of earth your body will be laid,
After all the respect we owe you are paid,
After giving us the wings of fire,
And igniting our minds to achieve lofty desire,
With indomitable spirit to take the nation ahead,
O guiding soul from the front you have lead,
With you as my idol I walk ahead,
With the spirit of India in my mind I tread.*

Contributed by Ms Jyoti Thatte, 19 State Bank Colony, Behind Police Line Takli, Nagpur-440013

Pluto's New Horizons

BIMAN BASU

The NASA space probe New Horizons that flew past Pluto recently revealed several features about the 'dwarf planet' unknown till now.

Artist's concept of the New Horizons spacecraft as it approaches Pluto and its moons.

EIGHTY-five years after its discovery, humankind has for the first time had a close look at the Solar System's most distant member, Pluto, now classified as a dwarf planet. The NASA space probe *New Horizons* flew past Pluto on 14 July, sending back the clearest images of it till date and revealing its detailed structure showing several features unknown till now.

Launched in 2006, *New Horizons* travelled for more than nine years and covered a distance of more than 4.8 billion kilometres only to spend under three minutes near Pluto as it sped past its target at a speed of more than 58,000 kilometres per hour. But it was the most rewarding brief encounter in space history. Icy mountains on Pluto and a new, crisp view of its largest moon, Charon, are among the several discoveries the probe was able to make during the brief flyby.

The success of the mission is by itself an unprecedented achievement of human

ingenuity and endeavour, especially if we remember that the target was so incredibly far away and that the tiny spacecraft was using technology which was decades old. Moreover, because *New Horizons* hurtled through the Pluto system at more than 58,000 kilometres per hour, a collision with a particle as small as a grain of rice could incapacitate the spacecraft.

After visiting Pluto the probe is headed towards deeper reaches of the Kuiper Belt – a vast region of icy objects beyond the orbit of Neptune that stretches at least 1.6 billion kilometres beyond Pluto – and will keep sending even more discoveries back to Earth. Researchers speculate it could continue operating well into the 2030s. Eventually it will escape the solar system entirely and join NASA's four other spacecraft that are also headed to or already in interstellar space: Pioneers 10 and 11, and Voyagers 1 and 2.

Because *New Horizons* is so far away, it takes about 4.5 hours for any data from the spacecraft to reach Earth. Even when

it arrives at Earth, the signal is so faint that NASA has to use 61-metre-wide radio dishes (one each in Australia, California, and Spain) to pick it up. This means an extremely low rate of data transmission: just about 1 kilobit per second, which makes *New Horizons* take more than 42 minutes to fully transmit an image that is 1024 pixels wide. According to NASA, at this rate, the entire data collected by *New Horizons* will take 16 months to be transferred to Earth.

One important outcome of the *New Horizons* mission has been the revised estimate of Pluto's diameter, which was shown to be about 3 percent larger – 2,370 km rather than 2,302 km estimated earlier. This makes Pluto larger than Eris, which has a diameter of 2,336 km. Before this discovery Eris was taken to be larger than Pluto and was a key factor for reclassifying Pluto as a dwarf planet. This new size estimate also implies that the lowest layer of Pluto's atmosphere is much thinner than thought, probably a kilometre or two, at most.

Discovery of Pluto

Pluto was not discovered till 1930. After the discovery of Uranus and Neptune beyond Saturn, American astronomer Percival Lowell first found hints of the



existence of an unknown planet beyond Neptune in 1905 from odd deviations he observed in the orbits of Neptune and Uranus. The deviations could be explained only by the gravitational pull of a planet beyond Neptune. Lowell could predict its location in 1915, but died before he could find it.

Then in 1929, a 22-year-old American farm boy and amateur astronomer named Clyde W. Tombaugh used the predictions made by Lowell and other astronomers and photographed the sky with a more powerful, wide-field telescope at the Lowell Observatory in Arizona. On 18 February 1930, he found Pluto's image on three of the photographs. The newly discovered planet was named Pluto, as suggested by an 11-year-old schoolgirl, Venetia Burney of Oxford, England. The name also honours Percival Lowell, whose initials are the first two letters of Pluto. Pluto became the ninth planet of the Solar System. It was found to go round the Sun once every 248 Earth years, with its distance from the Sun ranging from 4.4 billion kilometres when closest to 7.4 billion kilometres when farthest.

However, right from the beginning after its discovery, there appeared to be something odd with Pluto. It is extremely small in size – with a diameter of only 2,274 kilometres – smaller than our Moon and too small for a planet. Its orbit is the most unusual among those of the other solar system planets, tilting at an angle of 17° to the plane of the ecliptic, while the orbits of the other planets are almost

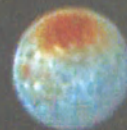
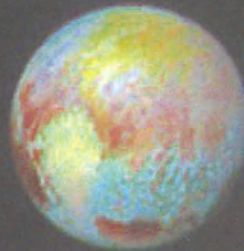
co-planar. Pluto's orbit is also highly eccentric, which brings it closer to the Sun than Neptune for part of its orbital period.

By the 1950s, some astronomers, most notably Dutch-American astronomer Gerard Kuiper, had suggested that Pluto was not a lone oddity but may be the largest and brightest of a vast collection of objects orbiting beyond Neptune, which was known as the Kuiper Belt.

New Horizons was launched on 19 January 2006, with the primary objective of exploring Pluto and other Kuiper Belt Objects. After launch it sped towards its destination at a breakneck speed of 48,000 kilometres per hour, becoming the fastest spacecraft ever to leave Earth. It crossed the orbit of the Moon nine hours after launch – a journey that took the Apollo-11 astronauts about three days.

In the meanwhile, more powerful telescopes began to reveal far-off objects beyond Neptune that rivalled Pluto in size, which put astronomers in a quandary. The need for a strict definition of planets was deemed necessary. Without

New Horizons image of Charon taken when the craft was closest to the Pluto system on 14 July 2015 from a distance of 466,000 km. It shows a collection of vaguely-defined features on the surface of Pluto's biggest moon. Now, with this latest capture, the New Horizons team has confirmed that the big dent in the icy surface of the moon shows a large impact crater, surrounded by a couple of deep canyons – one larger than Earth's Grand Canyon.



Composite image of Pluto and Charon, released by NASA on 13 July 2015.

a new definition, the discoveries of the new objects raised the prospect that there would soon be 50 or more planets in the Solar System. Astronomers did not like the idea. Finally, after years of discussions the International Astronomical Union (IAU) voted in 2006 to strip Pluto of its planet status and to classify it as a 'dwarf planet'.

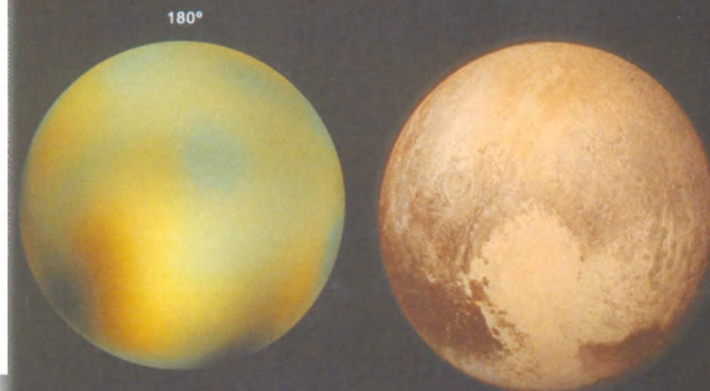
For a celestial body to qualify as a planet IAU set forth the following criteria: (i) It must be in orbit around the Sun; (ii) It must be large enough that it takes on a nearly round shape; (iii) It must have cleared its orbit of other objects.

While Pluto fulfilled the first two criteria, it failed to satisfy the last one, as it shares its orbital neighbourhood with other icy Kuiper Belt objects. So, Pluto was re-classified as a dwarf planet. Other than Pluto, four other dwarf planets are currently officially recognised in our Solar System. These are Ceres, Haumea, Makemake, and Eris. With the exception of Ceres, which is located in the asteroid belt, the other dwarf planets are found beyond Neptune. Astronomers estimate that there could be as many as 200 dwarf planets in the Solar System and Kuiper Belt.

Being extremely distant and small, not much could be learnt about Pluto from Earth-based observations. A major discovery about Pluto was made in 1979, when James Christy of the United States Naval Observatory noticed that photographs of Pluto taken earlier showed a bulge on one side. When he looked at photographs taken a few days before, he noticed the bulge was on the other side. He immediately guessed that Pluto had a moon. Christy named the new moon Charon after his wife Charlene.

Charon has a diameter of about 1,200 kilometres; that is, more than half of Pluto's. It is the largest moon in the solar system compared to the planet i





Pluto as imaged by Hubble Space Telescope (left) and New Horizons (right).

This map of Pluto, created from images (with resolutions of about 100 to 67 km per pixel) taken from 27 June to 3 July 2015, by the Long Range Reconnaissance Imager (LORRI) on New Horizons. The elongated dark area informally known as "the whale," along the equator on the left side of the map, is one of the darkest regions visible to New Horizons. (Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute)

orbits. Because the two bodies are so close in size, and they orbit about a centre of mass that is outside Pluto's surface, the Pluto-Charon pair is considered a double planet – the only one in our Solar System. Besides Charon, Pluto has four smaller moons named Nix, Hydra, Styx, and Kerberos.

Pluto spins on its axis from east to west once in 6 days 9 hours; the same time it takes its largest moon Charon to go round once. As a result, like a geostationary satellite of Earth, Charon appears motionless in Pluto's sky. If you were on Pluto, you would see Charon in the sky only from a certain area of the dwarf planet, always in the same position in the sky, without ever rising or setting. From the surface of Pluto, the view of Charon would be fantastic – it would appear 100 times larger than our Moon – but motionless in the sky!

But astronomers could find little about Pluto's size or surface conditions from telescopic observations because of its extreme distance from Earth. The first glimpses of Pluto's surface with some hazy details were available only in 1996 from images taken by the Hubble Space Telescope, which showed about 12 large bright and dark areas. But the Hubble images could not reveal much about Pluto.

New Horizons Mission

One reason why Pluto is of such interest to scientists is that it is different from every other planet in the Solar System. It is not a rocky planet like Earth, nor is it a gas giant like Jupiter. Instead, it is an ice dwarf; that is, a dwarf planet that is composed largely of ice.

The New Horizons mission to Pluto was officially selected out of two proposals for funding as part of NASA's New Frontiers programme in November 2001. The estimated cost of the mission (including spacecraft and instrument development, launch vehicle, mission operations, data analysis, and education/public outreach) was to be approximately \$650 million over 15 years (2001–2016). The spacecraft was originally planned to explore the only unexplored planet in the Solar System, as Pluto was still considered a planet when *New Horizons* was launched in January 2006. It is an irony that later in the same year, IAU relegated Pluto to the status of a dwarf planet.

New Horizons was launched on 19 January 2006, with the primary objective of exploring Pluto and other Kuiper Belt Objects. After launch it sped towards its destination at a breakneck speed of 48,000 kilometres per hour, becoming the fastest spacecraft ever to leave Earth. It crossed the orbit of the Moon nine hours after launch – a journey that took the Apollo-11 astronauts about three days.

New Horizons was indeed in a hurry. Since 1989, Pluto has been moving farther away from the Sun along its highly elliptical orbit. And as it moved farther from the Sun, Pluto could get so cold that its atmosphere might freeze for most of its 248-year trip around the Sun. Its daytime temperature was already a frigid -223°C and was dropping. *New Horizons* needed to get there before 2020, when the atmosphere could become a giant ice shell, blocking the probe from

studying the dwarf planet's surface and the dynamics of its atmosphere.

But the high speed also meant that it would be impossible for the spacecraft to slow down and observe Pluto for a longer time. That is why it sped past Pluto at a distance of 12,400 kilometres (roughly the distance from New York to Mumbai) in just under three minutes, but was close enough to map the surface in some detail. Earlier, to prepare for the Pluto encounter, *New Horizons* was woken up from hibernation on 6 December last year as a pre-set alarm clock roused it from its electronic slumber.

New Horizons carried seven instruments: three optical instruments, two plasma instruments, a dust sensor, and a radio science receiver/radiometer. The instruments were used to investigate the global geology, surface composition and temperature, and the atmospheric pressure, temperature of Pluto and its moons.

In addition to the science equipment, the spacecraft carried several cultural artefacts including a collection of 4,34,738 names stored on a CD, and a flag of the USA, along with other mementos. It also carried about 30 grams of ashes of Clyde Tombaugh, the discoverer of Pluto. The *New Horizons* spacecraft was designed, built, and is being operated and managed by the Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, Maryland, USA, for NASA's Science Mission Directorate.

Mountains on Pluto

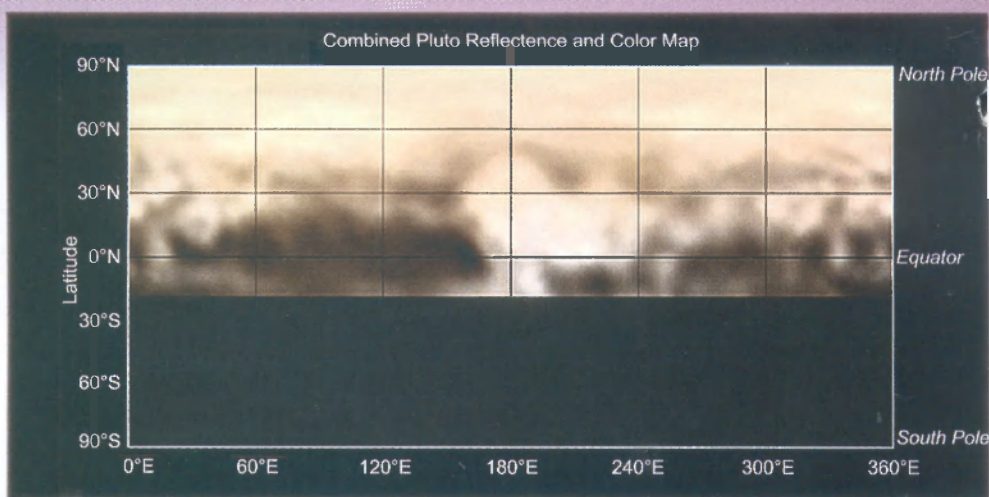
Close-up images sent back by *New Horizons* during the flyby were revealing. So far, a series of pictures from the spacecraft have revealed curious surface features, from a dark shadowy whale figure to a bright heart shape. But just what these shapes are, or what kind of terrain they represent, remains unclear. A close-up image of an equatorial region near the base of Pluto's bright heart-shaped feature showed a mountain range with peaks as high as 3,500 metres above the surface of the icy body. The mountain ranges have been named Norgay Montes after Tenzing Norgay, one of the first climbers to summit Mount Everest.

The close-up of Pluto also makes clear that the dwarf planet has water ice that is as hard as rock. According to mission scientists, the mountains on Pluto were likely formed no more than 100 million years ago, making them among the youngest mountains – younger than the Himalayas – in a 4.56-billion-year-old Solar System. This suggests the region, which covers about one percent of Pluto's surface, may still be geologically active today.

What surprised the scientists was the fact that there was no sign of craters, despite Pluto being part of the Kuiper Belt, the region beyond Neptune where

cosmic debris is constantly pelting the dwarf planet and its five moons. The scarcity of craters suggests that both Charon and Pluto have seen geological activity in the relatively recent past that erased the traces of earlier impacts, the researchers said.

Among other images taken during the flyby is one showing Charon, the largest moon of Pluto. The image showed a youthful and varied terrain, with a belt of troughs and cliffs that extends about 1,000 kilometres across the surface, which according to the scientists, suggests widespread fracturing of Charon's surface, probably the result of internal geological processes.

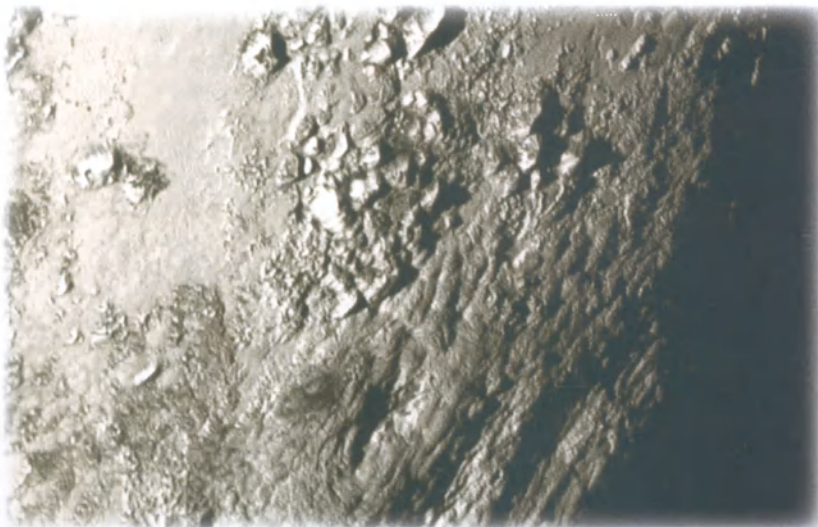


This image of Pluto from *New Horizons*' Long Range Reconnaissance Imager (LORRI) was received on 13 July. This side of Pluto is dominated by three broad regions of varying brightness. Most prominent are an elongated dark feature at the equator, informally known as "the whale," and a large heart-shaped bright area measuring some 2,000 kilometres across on the right. Above those features is a polar region that is intermediate in brightness. The plain lying within the heart-shaped region is now officially named Tombaugh Regio, after Pluto's discoverer. (Image credit: NASA-JHUAPL-SWRI)

The icy surface of the moon shows a large impact crater, surrounded by a couple of deep canyons – one larger than Earth's Grand Canyon. Charon's north polar region shows a dark marking which scientists believe is a thin deposit of dark material. This dark polar area stretches for about 300 km. Scientists have dubbed this dark pole on Charon with the nickname "Mordor," after a fictitious location in the novel *The Lord of the Rings*. The images also show a canyon estimated to be 7 to 9 kilometres deep north of the moon's equator.

Apart from unravelling the most distant member of the solar family, *New Horizons*' flyby of Pluto and its five known moons has also opened up the Kuiper Belt, an outer region of the Solar System populated by icy objects ranging in size from boulders to dwarf planets, for further exploration. Kuiper Belt objects, such as Pluto and Eris, preserve evidence about the early formation of the Solar System, which *New Horizons* and other missions may help unearth in future.

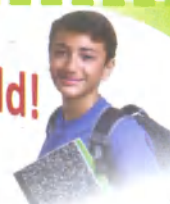
The renowned theoretical physicist and cosmologist Stephen Hawking has congratulated the *New Horizons* team and NASA following their successful mission to the dwarf planet Pluto. In a message to the team he said: "Revelations of *New Horizons* may help us to understand better how our Solar System was formed."



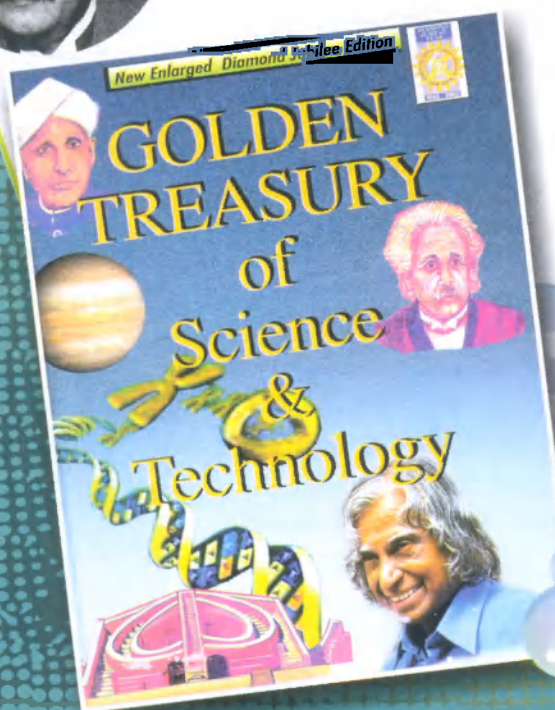
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Eating Bark to Survive

Tree-bark is not very nutritious though a large number of animals, ranging from mites to elephants, rely on bark for their sustenance especially during periods of food scarcity. This article takes a look at some such animals that feed on bark.

DIPANJAN GHOSH AND AYAN MONDAL

UNDER the onslaught of the vagaries of nature, animals often survive by adapting their food habits. Sometimes even the very tough and dead bark of a tree can serve as food in times of food scarcity. Termites feast on the bark and even the largest land animal elephant is included in the consumer list.

'Bark eater' is an English translation of the Mohican word 'Adirondack,' a term the Mohawk once used for Algonquian-speaking tribes who were said to eat the inside of the bark of the white pine when food was scarce. But the human race has now successfully relinquished its habit of devouring bark.

The human digestive system is not suitable for consuming raw bark and wood of plants. As a result, we avoid direct consumption of these materials. Of course, some bark is taken as medicine. Cinnamon bark is used in our cuisine quite indiscriminately as a condiment. However, *Australopithecus sediba*, believed to be an early relative of modern-day humans, enjoyed a diet of bark along with leaves, fruits and nuts. This finding also proves that in the Early Pleistocene, our ancestors probably lived in a more wooded environment than is generally thought and they had a tradition of eating the bark.

Many animals of the geologic past would use tree-barks as their food. For instance, *Lufengosaurus huenei*, an extinct prosauropod dinosaur that lived during Late Triassic to Early Jurassic period in Southwestern China. The fossil gastroliths (stones held inside the gastrointestinal tract) recovered from the rock beds reveal that *Lufengosaurus* used stones to grind tough plant matters including bark.

Edible Bark

Bark or rhytidome refers to the dead corky layers wrapping the stems and roots, which protects the woody plant from outside stresses to some extent. All the tissues outside the vascular cambium are contemplated as bark. In this regard, the living phloem or food-conducting tissue of a tree trunk is also regarded as bark, and it can be referred as the living bark or inner bark.

The living cells of the inner bark contain nutrient-laden cell sap, organelles, and stored starch. Most importantly, the phloem cells with their sugary contents are located here. The inner bark is the

chief target for animals that feed on the bark. Young twigs and branches are preferred because they have a higher proportion of inner to outer bark and lower concentrations of anti-digestive compounds like lignin and phenol.

Barks of some trees and shrubs satiate the taste of a large array of animals. So, an animal gnawing at the bark and soft wood of trees and shrubs is not a malicious act or evidence of a neurotic condition. Instead, it is often a normal means by which some animals acquire food.

However, the bark is basically the less nutritious part of a tree. It is mainly



[Photo Dipanjan Ghosh]

Cinnamon (*Cinnamomum zeylanicum*) bark is the chief source of commercial cinnamon



The rusty millipede is a good eater of tree-bark

[Photo: Souvik Mukherjee]

composed of complex carbohydrates like cellulose, lignin, suberin, pectin, etc. Plant bark also contains a large variety of phytochemicals such as non-protein nitrogenous compounds like alkaloids, cyanogenic glycosides; phenolic compounds, tannins; terpenoids, saponin and phenylpropanoids; various organic acids like salicylic acids, jasmonic acids, etc., and some other secondary metabolites.

Besides, due to the decay caused by certain environmental factors along with various microbial activities on the bark surface, plant bark possesses huge amounts of dead organic matter on its surface and crevices. The



A termite in action – assessing the trunk surface

[Photo: Ayan Mondal]

ability to consume this seemingly unpalatable food supply and derive nourishment from it requires specialized feeding habits and digestive systems. Mammals lack complex carbohydrate (mainly cellulose) degrading enzymes. Only a few ruminants and some gnawing mammals including rodents have symbiotic micro-organisms in their gut that help in the digestion process. As bark is not easy to consume, it is largely ignored by the higher animals in the season of plentiful sustenance. However, when food is scarce, animals often turn to tree branches and eat bark as their main diet.

Tiny Bark-eaters

Small creatures especially insects are ravenous eaters. Many of our serious and damaging insect pests feed on the bark and wood of trees. These insects attack trees that are weakened by old age, drought, overcrowding, root diseases, or weather damage. Certain tiny organisms like bark-lice, mites, mealy bugs and scale insects consume bark.

Bark beetles and wood borers bore through the bark to eat the tasty nutrients in the inner bark and cambium layers. The giant African snail, the Asiatic rhinoceros beetle and some grasshoppers as well as millipedes are also keen bark-eaters. However, the most consummate wood feeders are the termites that literally seek living trees in the forests to devour aggressively and relentlessly. Bark eating caterpillars of a lepidopteran moth *Indarbela tetraonis* feed on bark during night. In the next day morning, the attack by this pest is characterized by the presence of long winding, thick, blackish or brownish ribbon-like masses composed of small chips of wood and excreta.



[Photo: Ayan Mondal]

Irrespective of their sizes, scale insects are voracious eaters



[Photo: Ayan Mondal]

A long-horn beetle



[Photo: Ayan Mondal]

3-horned grasshopper – a keen bark-eater



[Photo: Kushankur Bhattacharya]

Giant African snail (*Achatina fulica*)



[Photo: Indrajit Adak]

Asiatic rhinoceros beetle (*Oryctes rhinoceros*)

Degradation of ingested bark and woody material occurs within special compartments of the stomach, or coecum, or an exceptionally long intestine,

A Feast of Tree Bark

Many mammals ranging in size from the mice to elephants consume bark and woody branches. In the temperate forests of North America and Europe, smaller mammals like voles (*Microtus agrestis*), badgers (*Taxidea taxus*), rabbits (*Lepus californicus*) and porcupines (*Erethizon dorsatum*) often eat bark at the base of trees, sometimes leaving individual marks of biting on the tree trunk.

Squirrels prefer to gnaw the bark of sumac, crab apple and some bushy species of roses. The bark of aspen and willow is an important food source for the European beaver (*Castor fiber*).

Beaver is the only animal that chews away large chips of wood in order to fell trees. Larger herbivores such as goat, deer, tapir (*Tapirus bairdii*), rhinoceros, giraffe, etc., often eat the bark of tree branches. Deer usually bite off twigs and chew bark which they rip off in strips. During this practice, deer also damage bark by fraying their antlers on it to shed the velvet coating. Unlike other animals, giraffe can easily reach higher branches further above the ground.

The largest land animal elephant eats a huge amount of forage every day. A major part of elephant's diet



A striped squirrel (*Funambulus pennanti*) on a tree

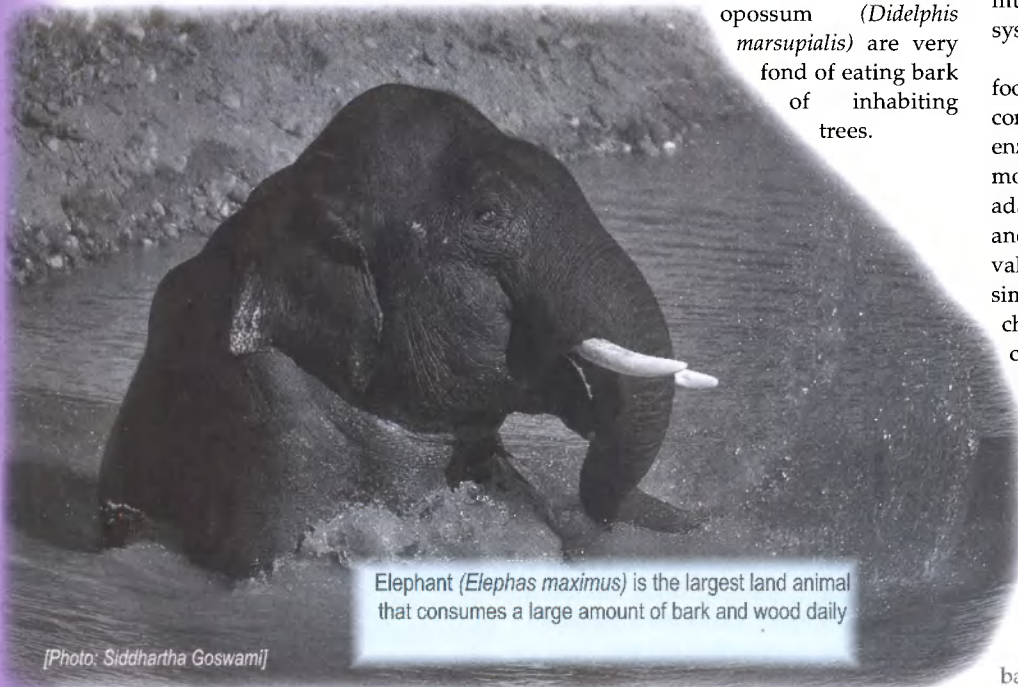
is composed of various types of tree-bark and woods, viz., acacia, baobab, elephant apple, silk flower, rain tree, etc. Primates generally avoid eating bark although gorilla and golden monkey (*Cercopithecus kandti*) seldom eat tree-bark. Even some marsupial mammals like koala (*Phascolarctos cinereus*), tree kangaroo (*Dendrolagus ursinus*) and opossum (*Didelphis marsupialis*) are very fond of eating bark of inhabiting trees.

Animal Gut

Although certain micro-organisms and insects (sometimes empowered by protozoans inhabiting their digestive tracts) can consume bark and wood of trees easily, it is quite difficult to digest such food items by the larger animals. To assimilate bark and wood as food, animals must possess specialized digestive systems and necessary enzymes.

For animals, the breakdown of foodstuffs is accomplished through a combination of mechanical grinding and enzymatic processes beginning in the mouth. In carnivores and omnivores, adapted to eating meat as well as fruits and nuts with their concentrated food value, the digestive system is relatively simple. Strict herbivores have a big challenge since the vegetation they consume is a far less concentrated food, more difficult to digest, and often protected by defensive chemical compounds like alkaloids and other secondary metabolites. In addition, the rigid cell walls of plant material (comprising complex carbohydrate macromolecules) must be broken down to gain access to proteins and carbohydrates inside the living cells.

Further degradation of ingested bark and woody material occurs within



Elephant (*Elephas maximus*) is the largest land animal that consumes a large amount of bark and wood daily

[Photo: Siddhartha Goswami]



Despite their tough skin, rhinos feed on soft inner bark of trees

Photo: Asok Kumar Majumdar

special compartments of the stomach, or coecum, or an exceptionally long intestine, or an enlarged colon with the aid of inhabiting microbes and protozoans by a process known as fermentation. Millions of such microorganisms secrete cellulases, hemicellulases and other digestive enzymes that in turn release sugars, organic acids, and amino acids from the woody materials ingested by the host animal during feeding.

The stomach of herbivorous animals may be of two distinct types –

monogastric, i.e., made up of a single sac-like compartment and digastric, i.e., complexly subdivided into various chambers. In monogastric herbivores such as horses, rhinoceroses, rodents, and rabbits, cellulosic material is digested by microorganism-aided fermentation in the intestine, often modified to have either a coecum or enlarged colon. In digastric animals like antelope, deer, moose, camels, sheep, goats, and cattle, the stomach is divided into four chambers, containing symbiotic microorganisms.

Strict herbivores have a big challenge since the vegetation they consume is a far less concentrated food, more difficult to digest.

These animals only partially chew their food as they quickly gather it for the first time. Later when resting, they regurgitate and re-chew it. The cellulosic material is digested by microbes and protozoans residing within the rumen.

Certain monogastric mammals like rodents and rabbits exhibit another phenomenon to increase the digestion of their food by eating 25 to 60 per cent of their faeces. This is known as coprophagy. For such practice microorganisms within the gut get enough opportunity to digest the coarse food particles.

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Deer eat a large variety of tree-bark during their life time

Photo: M. Z. Khan



Inflation, Multiverse and Anthropic Principle

UNIVERSE by definition includes everything that ever was, is, or shall be. It includes the totality of our observations, experiences and thoughts, of all the past, present and future times. There cannot be anything outside the universe, and hence the question "what lies outside of the universe" is meaningless. However, during the twentieth century, many of our conventional ideas and wisdom were turned upon their heads. Our ideas of the universe may also prove to be one such.

The story of the universe began at the beginning of time with a quantum fluctuation of the vacuum that created the universe as an immensely hot fireball at

the Big Bang. The Big Bang was followed soon afterwards by the phenomenon of 'inflation' that expanded the space increasing the size of the universe from sub-microscopic, sub-nuclear scales to scales we are familiar with. This unusual expansion happened at superluminal speeds after the universe came into existence from a tiny quantum fluctuation. It made the universe flatter, smoother and uniform, the way we observe it today.

But this mystic-like phenomenon of inflation might have contained the seeds of many more universes outside of our own which shall forever remain unobservable to us, outside of our reach and causally disconnected from our universe. In fact, ours may be only one universe in a 'multiverse' – one in an infinity of island universes scattered throughout the vast

cosmological expanse, like 'countless bubbles in an eternally frothing sea', where new universes spring up every now and then.

Multiverse is a picture of random universes and many cosmologists are unable to reconcile themselves with the idea of this randomness which, in their opinion, militates against the idea of certainty and uniqueness which characterise theories about the universe, notwithstanding the quantum theory. The idea of multiverse may look borrowed straight from science fiction, but actually it is logically consistent with scientific explanation of the evolution of our universe, as we shall presently see. This also brings back the so called 'Anthropic Principle', once rejected by Stephen Hawking as 'counsel of despair'.

A series of experiments that captured the fingerprints of the Big Bang were conducted through four generations of telescopes, the results of which have just started trickling in.

Inflation, which is the key to explain many of the strange properties of the universe like its flatness and observed uniformity, was a short-lived phase in the history of the nascent universe. It took place between 10^{-35} and 10^{-33} second, doubling the size of the universe every 10^{-34} sec, at the end of which the universe had increased in size by 10^{28} ($\sim 2^{100}$) times and acquired dimensions in which gravity could no longer bring about the collapse of the Universe, being balanced by the force of this expansion.

Having just been born into existence from a quantum fluctuation of the vacuum, the universe was dominated by vacuum energy, and the size of the universe being small at that time, the vacuum energy density was very high. In such a scenario, the universe began to expand exponentially at speeds greater than the speed of light. The rapid exponential inflation increased the radius of the universe to such an extent that it started looking flatter and much less curved, thus solving the problem of the observed flatness of the universe. This expansion expanded the universe to a scale from which the Hubble expansion carried it forward at a much reduced rate to become the universe of today.

The other problem it solved was the observed uniformity of the universe. The theory of inflation says that the acceleration of the Universe was driven by the energy of the vacuum – there being nothing else – that acted like a ‘Cosmological Constant’ and caused such rapid expansion. This implies a very high vacuum energy density – far higher than can be extrapolated from the observed energy density at present – in the universe at that point of time. This is where the theory of multiverse comes in.

Till the 1980s, we had no means of

measuring the density of vacuum energy or the Cosmological Constant, but the sedate rate at which the universe was expanding implied a value close to zero. But in the late nineties, the density of vacuum energy could be calculated; it was found to be 10^{-11} Joules per cubic metre, equivalent to 6×10^{-27} kilogramme per cubic metre of space, which is very close to zero. This flew in the face of quantum mechanical calculations suggesting a far higher vacuum energy density of 10^{119} Joules per cubic metre, equivalent to about 10^{100} kilogrammes per cubic metre of space in the universe, given the initial conditions prevailing at the Planck time (10^{-35} sec) when quantum gravity dominated the new-born universe.

This value of vacuum energy was so large that it would tear all atoms apart so that no structure would be possible in the Universe. But the absurdly tiny observed value of the cosmological constant, smaller than the calculated value by a factor of 10^{120} , appeared highly random. Something apparently was seriously wrong somewhere.

The problem is resolved if we allow probability to play a part in the early universe. We can then imagine that there is an ‘ensemble of universes’, each with own specific value of vacuum energy density, the densities forming a continuum from high to low values, and our universe occupying a lower value closer to zero energy density. Speculative though it might seem, it beautifully solves many thorny theoretical problems that have beset the theory of the early universe for a long time. Apart from the problems of flatness (flatness problem) and uniformity of the universe (horizon problem), there was the seemingly unknowable riddle of St. Augustine era – what happened before the Big Bang singularity?

Imagine in a universe of sub-nuclear dimensions, dominated by vacuum energy, a tiny sub-domain, a microscopic bubble being blown up and getting inflated in an exponential manner, ultimately to become the universe whose features would be familiar to us. But then there would be many isolated pockets of space-time in that bubble, each a potential seed for a new universe which would expand in its own way to become a separate universe.

Given the smallness of the region, quantum gravity would determine the nature of such expansion and its consequence. Because of quantum fluctuations, there would be tiny variations in the vacuum energy density of different bubbles within the microscopic regions of space that would start inflating in this manner.

Even the tiniest variations in the initial conditions between these expanding bubbles would end up in very different universes, with different properties and different physical laws for each, depending on when and how much vacuum energy is released in each case. Emerging from quantum nothingness, they would be floating, bubbling, colliding and expanding in an ocean of creation, a ‘boiling cauldron’ of an infinity of tiny universes in a ‘multiverse’.

In fact, as Alan Guth, who pioneered the theory of inflation, has argued, inflation, once started, may never stop completely. Physicist Andrei Linde showed that it need not have been even a one-time event. Conditions for inflationary expansion may arise anywhere anytime, making new island universes pop into existence in the ocean of space by ballooning of such regions, ‘with new universes sprouting from far flung regions in the old, generating a



Alan Guth, who pioneered the theory of inflation, has argued, inflation, once started, may never stop completely.

never ending web of ballooning cosmic expanses', as Brian Green writes in his book, *The Elegant Universe*.

The vast majority of these universes may not have conditions familiar to us. However, in those universes where they can support life, there would be endless possibilities of creation of different life forms, but we shall never ever be able to establish any contact with any of them, being causally disconnected from them forever.

Guth reasoned that this inflation could have been caused by a phase transition if the Universe was in a metastable state in its very early phase, and its lowest energy state was lower than the lowest energy state in the post-inflation phase, the difference between the two energies – something like 'the latent heat of the universe' – providing the energy necessary for such rapid expansion. This energy spread throughout the Universe would act something like a 'Cosmological Constant' ensuring constant energy density in every cubic metre of space within it, driving the expansion of the newborn Universe at ever faster speeds, even exceeding the speed of light.

This expansion of the Universe at superluminal speeds would also be perfectly consistent with Einstein's Relativity, according to which no material particle can travel through space at speeds faster than that of light, but does not prevent space itself from expanding at faster-than-light speeds, carrying everything along with it to far distant corners of the Universe light does not yet have the time to reach.

As the Universe started expanding in a hot, chaotic state, with little matter at 10^{-35} sec and expanded 10^{28} times before 10^{-30} sec after which the rate of expansion slowed down to the rate predicted by the Big Bang theory (the current flatness is explained by exponential expansion by a factor equal to e^{60} which is about 10^{26} . 10^{28} is a reasonable approximation of this). During this infinitesimally small duration, the Universe was practically a vacuum.

As it expanded, it was cooled and a 'phase transition' took place, like water cooling to ice at 0° centigrade. But if the water cools rapidly, it may attain sub-zero temperature without having to freeze at 0° Centigrade, and will remain in this state for a while before freezing to ice. This phenomenon is known as super-cooling, in which water is cooled below the freezing point without turning into ice. As it forms ice, the symmetry of water is broken and, thus, this phase transition breaks the symmetry.

During inflation also, the Universe was super-cooled below the temperature at which symmetry breaking and particle production could normally take place. Being unstable, the Universe could not remain in this state for long – particles and antiparticles soon precipitated out of the energy of this vacuum and a phase transition occurred, breaking the symmetry when the electro-weak and strong nuclear forces forked out, never to meet again in future. The rapid expansion also smoothed out any wrinkles and irregularities in the very early Universe, which explains why the Universe today is so uniform and homogeneous.

The symmetry was broken by the Higgs fields. As the symmetry of the Universe broke spontaneously, gravity started to assert itself on matter. The gravitational energy of the Universe is negative because we have to expend energy to pull apart particles being attracted to each other by gravity, and the more negative it is, the bigger the Universe is. But the matter energy, being equivalent to $E=mc^2$, is positive.

As the Universe inflates, the gravitational energy becomes more negative, and for conservation of total energy, the matter energy must therefore increase, the two cancelling each other; and so matter particles are created to account for this increase in matter-energy. Thus, all the matter and energy in the Universe as known today were showered into existence by the process of inflation. This could explain why there was so much matter in the Universe (as many as 10^{80} particles of matter).

Lawrence Krauss describes in his book *A Universe from Nothing*, "the inflating region will separate those regions that first exit inflation by almost unfathomable distances. It is like lava pouring out of a volcano. Some of the rock will cool and solidify, but those rocks will be carried far apart from one another as

they float on a sea of liquid magma." Our universe is just one of these rocks, in fact, a distant lonely outlier in the multitudes of universes in the multiverse, with a value of energy density quite close to zero. In fact such a universe has extremely low probability for existence, but nevertheless a positive probability.

And this is where the 'Anthropic Principle', hotly debated among scientists and philosophers, comes into play. The term 'anthropic principle' (from Greek *Anthropos* meaning 'Human') was coined by Brandon Carter, an Australian physicist in 1973 in a symposium organized to celebrate the 500th birthday of Copernicus. It has been an enigma to the physicist that all fundamental physical constants of the universe happen to have values lying within a very narrow range; just outside of this range, there would be no structure, no galaxy, no planets and no life as we understand it.

Somehow these constants seem to have just the right values for life to evolve in a planet called earth that lay at the right distance from the sun in a solar system in our galaxy where water exists in the liquid form in which large molecules of carbon and hydrogen can find an environment to evolve into complex proteins and then to life forms. It seems that the physical Universe has evolved in a way to facilitate the emergence of sapient life and sentient beings capable of observing the universe in a 'context sensitive manner'. It seems the universe has the right age and the right values of its fundamental physical constants necessary to accommodate conscious life.

The anthropic principle just says that 'it is overwhelmingly more likely that we have evolved in conditions suitable for our evolution'. It comes in two forms, strong and weak anthropic principles. The strong anthropic principle which is an extension of the weak anthropic principle says that it is overwhelmingly likely that the universe is such as to permit the evolution of intelligent creatures like us. Anthropic principle is often dismissed as a mere tautology, a 'logical truth empty of empirical content'. But it is actually not a tautology, but only a probability, restricting the range of possible universes that could have existed to those that can generate intelligent life.

We have seen earlier that the energy of empty space, which is the Cosmological Constant represented by the Greek alphabet Lambda (λ), is gravitationally



The gravitational energy of the Universe is negative because we have to expend energy to pull apart particles

repulsive. If it was dominant in our universe before the galaxies were formed, the repulsive force due to this energy would have prevented the formation of any galaxy. Then there would be no stars, planets or sentient observers in the universe, which is obviously not the case with us.

Curve I plots the energy density of all matter in the universe, and the energy of empty space both as functions of time. As the universe expands matter gets diluted, being scattered through increasing vastness of space and the density of matter falls as a consequence. The energy density of empty space, however, remains constant, there being nothing in empty space to get diluted. The two curves cross close to the present times.

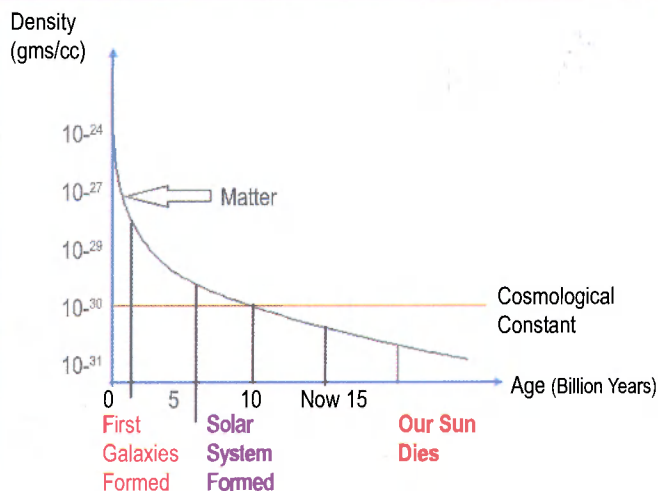
If γ was higher they would cross at earlier times, before the formation of galaxies, and then there would be no structures in the universe. It would remain forever empty, an ever-expanding bubble of nothingness. Thus the possibility arises that γ was selected anthropically, so that we can live in a universe where galaxies can form and life can evolve into intelligent humans to observe the universe.

The multiverse theory explains why our universe is what it is and why we are here to wonder about all this and explore into its secrets, exactly what the 'anthropic principle' also implies. As we have seen earlier, inflation would result in an infinity of universes coming into existence with different properties and different physical laws, so that the Cosmological Constants would also have different values. Thus we have a range of values and hence a probability distribution of the energy of empty space in them.

Most of these values would lie within a region that makes life impossible, and the universes would be sterile, uninhabitable and empty. But fortunately for us, there was an outlier in this ocean of universes that had vacuum energy very close to zero and that is why we could evolve in it to observe and wonder about its marvels. A fortuitous event, like itself but nonetheless within the range

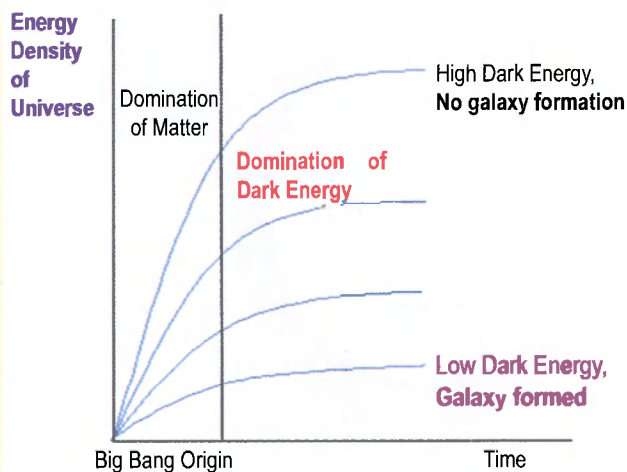
Curve I: Evolution of Structures in a universe with low value of Cosmological Constant

(Adopted from Lawrence Krauss's book *A Universe from Nothing*, pp 124.)



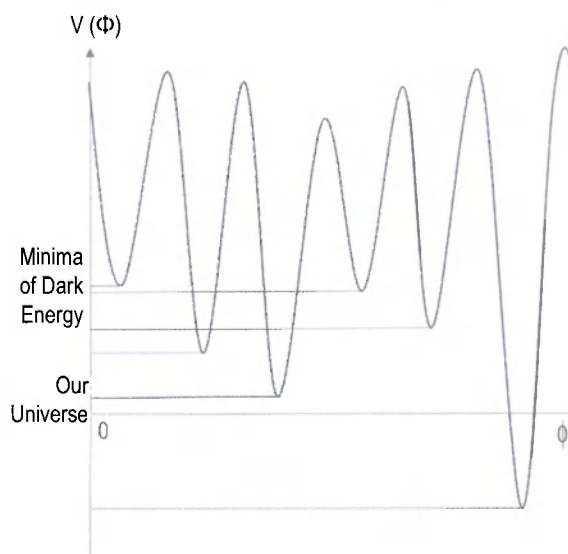
Curve II: Variation of Energy Density in Multiverse

(Adopted from John Peacock, *Anthropic Principle and Cosmology*, <http://creativecommons.org/licenses/by-nc-sa/4.0>)



Curve III: Minima of Vacuum Energy States in the Multiverse

Source: *Ibid*



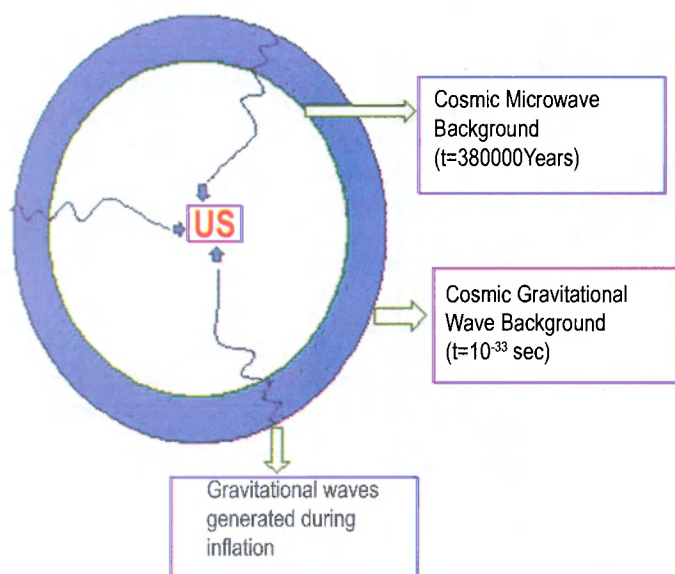
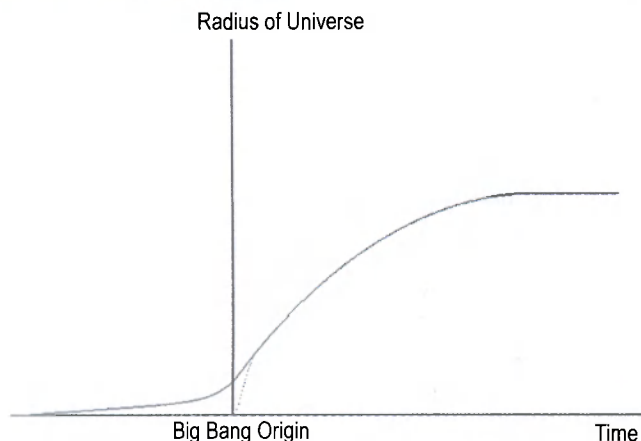


Figure 1: Gravitational Waves from Inflation Era penetrating the CBM and reaching us

of possibilities, and a possibility that actualised (Curve II).

In a universe dominated by matter, gravity clumps matter forming large-scale structures. Once structures are formed, it does not matter if dark energy starts dominating. Once dark energy starts dominating, universal expansion rate accelerates slowing down the process of structure formation. Steven Weinberg, who in 1987 realised that a large value of dark energy would suppress the formation of structures, applied the anthropic principle to explain the low vacuum energy of our universe.

The multiverse idea also gets support from the String Theory. Higgs Field (Φ) provides a mechanism for inflation. Higgs Field permeates the entire space with a non-zero value at every point. In the parlance of the physicists, it is a 'scalar

field', like the gravitational field, in which the potential energy of a particle depends only on the position of the particle.

Higgs field dynamics explains how the value of vacuum energy density falls from a high value to a low value. But instead of a single minimum value of the 'vacuum state', it can have several different minima in it, each corresponding to a potential level of the dark energy ($V(\Phi)$) and hence a different universe, and there is likely to be one with energy close to zero, as observed in our universe (Curve III). String Theory in recent times has predicted about 10500 of such minima.

And finally we come to the question – What was before the Big Bang, if ever anything could be? So far we have a perfectly consistent picture of a universe originating at the Big Bang that inflated

and became many universes and in this multiverse we evolved on the one that had the most likelihood of harbouring life.

Suppose we remove the Big Bang singularity (Curve IV), and have a picture of a universe that, as the University of Edinburgh physicist John Peacock says, "could have just been growing exponentially for an indeterminate time. So the universe is much older, which is another way of understanding how it could be so uniform."

Big Bang thus could just be 'an illusion', but to come up with a definite answer, we have to first decipher completely how 'the vacuum energy could change precipitously with time in this way'. As he says, this is an intoxicating package of ideas that can solve all known problems of cosmology.

But science never accepts any idea, however intoxicating, without concrete proof. The question is, is there any way to testing the inflation theory that has thrown up all these interesting possibilities, going back to the beginning of time when quantum mechanical fluctuations had 'seeded' the galaxies and large-scale structures of the universe?

The Cosmic Microwave Background (CMB) that was detected in 1964 belonged to an era after 380,000 years from the Big Bang, before that the universe was opaque to light, so light signal cannot be used to probe deeper into the past. But fortunately, we may have another tool – the relic of gravitational waves that were generated during inflation that would enable us to peep into that distant past when the universe had a size less than that of a pea.

For that we have to go back to the very fabric of space time when it was getting stretched at unbelievable speeds during the inflation era, an era that lasted less than a billionth of a trillionth of a trillionth of a trillionth second creating ripples in the fabric of space time. These ripples are called gravitational waves; they would compress space-time in one direction while stretching them in another. The continued expansion of the universe ever since would have stretched these ripples almost beyond recognition today, which is why they have remained undetected so far. That is, until now.

Gravitational waves can be detected only by the distortions they cause in matter or radiation that we can observe

COSMIC CURL

The BICEP2 instrument observed a faint but distinctive twisting pattern, or spin, known as a curl or B-mode, in the polarization of the cosmic microwave background. This is the first evidence for gravitational waves generated by rapid inflation of the Universe some 13.8 billion years ago.

Spin Intensity

■ Clockwise ■ Anti-clockwise

— Polarization strength and orientation at different spots on the sky.

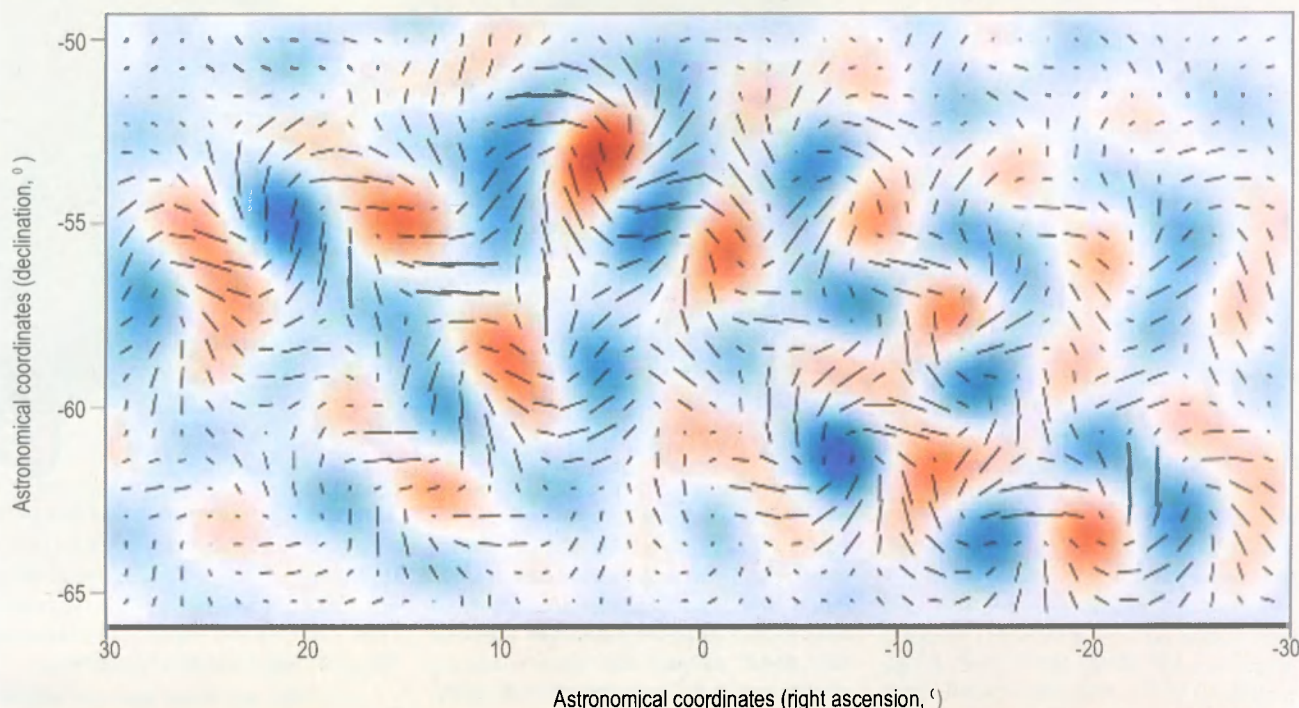


Figure 2: Swirling patterns in the polarisation of CMB caused by Gravitational Waves

Source: <http://www.nature.com/news/telescope-captures-view-of-gravitational-waves-1.14876>

Our sight cannot go beyond the CMB, the last scattering surface, the afterglow of the Big Bang that surrounds us everywhere, in all directions, uniformly. Like receding sea-waves leaving their signatures in ripples of sand on a beach, gravitational waves must also leave their marks on the CMB (Figure 1).

Thus, like the CMB, we should also have a Cosmic Gravitational-Wave Background (CGB). Scientists predicted that CGB would imprint its own unique signature, albeit very faint, in the polarization of the CMB, by polarising the radiation 'in a curly, vortex-like pattern known as the B mode'.

To detect these waves scientists from the Harvard-Smithsonian Centre of Astrophysics at Massachusetts built super-sensitive microwave radiation detectors, mounted them on telescopes at the South Pole and after continuous observation and painstaking analysis of data spread over a period of nine years,

were finally able to detect a 'swirling pattern in the Cosmic Microwave Background' created by 'gravitational waves from the beginning of the universe'.

This was the most direct evidence of the existence of gravitational waves and the 'most convincing evidence of inflation'. It was a Big Bang moment for physics, looking into the moments just after the birth of the universe.

The series of experiments that confirmed the existence of gravitational waves and to capture the fingerprints of the Big Bang were conducted through four generations of telescopes, with increasingly advanced sensitivity to B-mode polarization: BICEP1 (Background Imaging of Cosmic Extragalactic Polarization) (2006-2008) with 98 detectors, BICEP2 (2010-2012) with 512 detectors and five Keck Array (2011-2013) telescopes, each with 512 detectors, and BICEP3 (January 2015) with 2560 detectors.

BICEP2 results were declared on 17th March 2014, which might be a landmark date in the history of science. Apart from confirming inflation, it was also the 'first ever experimental evidence for quantum gravity' that dominated the newborn universe.

The latest series of experiments by BICEP3 beginning January 2015 are likely to dispel the apprehension of some scientists that the observed patterns could have been caused by signals generated from the cosmic dust lingering between the stars in our galaxy. That would put a final stamp of approval to the theory of inflation and the existence of multiverse.

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KIRAN S. MIRLE

In the password for his email, he indicated 'pi' as 'pie'. Similarly, is there a rhyme for 'stream coloured body'.....



The Password

KEEPING the tennis racket in its place, the sprightly and round-faced Tanu looked curiously at her father Mr. Sen as he walked in. Mr. Sen smiled and said: "So, how was your tennis today, Tanu?"

"My backhand has improved during this school vacation," responded Tanu. Tanu liked sports, but she also liked listening to her father speak about current affairs and had inherited his love of science.

"Are you game to try out your wits for a change?" asked Mr. Sen.

Tanu's intelligent eyes twinkled with curiosity. "Sure, tell me what the puzzle is," she said.

Mr. Sen's smile disappeared as he said: "You must remember Dr. Murthy, who works in our hospital." Mr. Sen worked in the same hospital as Dr. Murthy and the two of them belonged to a group of friends.

Tanu nodded as Mr. Sen continued: "Sadly, he expired a few days ago due to a massive heart attack. He was trying out a new medicinal drug and had stored the information related to it in his computer, in the hospital. The problem is that we are unable to log in to his computer, since it is password protected. I suppose we can ask the IT technicians to try and recover the data, but we would prefer to do that as a

last resort, since the computer contains data about patients and we are unsure whether we can keep the confidentiality of the data. Besides, Dr. Murthy was a forgetful man. He has told his wife about a diary that contains all his passwords. We have the pages from the diary containing the passwords with us, thanks to his wife. Still, the passwords continue to elude us."

Tanu was flummoxed. "If he has written the passwords, why should they elude you?" she asked.

Mr. Sen rubbed his spectacles slowly as he explained: "You see, Dr. Murthy did not write the passwords themselves in the diary. Instead, he wrote words and phrases – mnemonics that would help him remember the passwords. All passwords that he used, for his emails, his bank accounts, etc. are written as mnemonics. Of course, his wife has changed the bank related passwords now, before handing us the diary. He had shared most of the passwords with his wife, like his bank password but not the ones related to work. So, we are stuck for the moment. I know you like solving crosswords and other puzzles. Do you think you can try and find out the password for his computer?"

Tanu was intrigued at the prospect! She felt like an intrepid detective herself.

"Yes, I will try and identify the password from the clues," she told her father.

"Good, I will bring you a photocopy of the pages from Dr. Murthy's diary tomorrow."

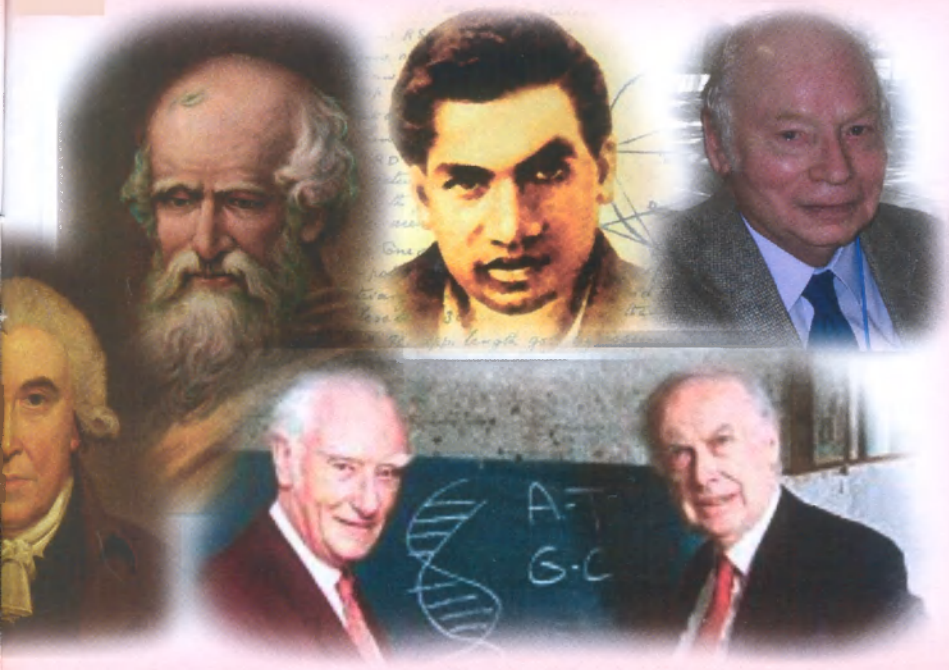
Tanu anxiously looked forward to the evening of the next day. When Mr. Sen came home from work the next evening, he found Tanu expectantly waiting for him. Smiling, he sat down on the sofa and handed over a couple of pages photocopied from Dr. Murthy's diary. Tanu eagerly looked at the pages, skimming through them first.

She saw an ordered handwriting with neat flowing lines on the lines of the page. There were sections marked for Dr. Murthy's email accounts and bank accounts. One of the sections was "Email: Greek maker of pie". "That's the password to his email account," said Mr. Sen.

Tanu said: "I will need to search this one out on the Web: it is probably a Greek pie or a famous Greek cook."

"Hold on," said Mr. Sen, smiling. "Surely, you don't think that the password is a literal translation."

Tanu paused as she opened up her father's laptop. "Hmm, I didn't think of that. I suppose it could be a combination of 'Alpha' and a synonym for 'pie'," she said.



In the last couple of days, she had learnt about the Ramanujan Hardy number, about James Watts and about Dr. Watson and Dr. Crick. A world of knowledge beckoned her. As she headed back, she made a resolution that she would learn more about genes and about the life of Ramanujan.

sounding a little doubtful. Mr. Sen beamed at her and said: "That's better, Tanu. Now, Dr. Murthy's wife has told us the password. So let us see if you can tell me what it is before you take up the password for the computer!"

"No," screamed Tanu in mock anger.

Mr. Sen went towards his room. "I will give you a clue though: Sounds are important," he said as he entered his room.

Alone, Tanu's mind began working furiously. She thought: "Pie and maker of a pie: it could mean a cake or the baker of a cake. Why mention it as a Greek pie? Is there a Greek alphabet as part of the password? Wait a minute: the clue Dad gave me was about sounds. What sounds like 'pie'? Could it be 'pi' in which case, the maker of pi would be ...". Excited, Tanu got up. "Archimedes, Archimedes!" she shouted with delight.

Mr. Sen heard her and came out: "Very good, Tanu. You have caught on quickly. Indeed, the clue refers to both Archimedes who is supposed to have calculated pi first and then to pi itself. In fact, the password is 'Arch3141', a combination of Archimedes and the first 4 digits of pi."

Tanu felt elated that she had been on the right track, aided by her father's clue. She looked at the page again. One section said PIN: Ramanujan Hardy number. Puzzled, Tanu looked at her father. "What's the Ramanujan-Hardy number, Dad?" she asked.

"You must be aware of the friendship

between India's famous mathematician Srinivasan Ramanujan and the British mathematician G.H. Hardy. Once Hardy came to visit Ramanujan in a cab numbered 1729 and commented that it was a dull number. Ramanujan replied that it was certainly not a dull number. This is the smallest number that can be expressed as the sum of two cubes."

Tanu continued to look puzzled. A patient Mr. Sen asked: "What is 12 cubed?"

Tanu had to use the calculator to get the answer 1728. "So, $1729 = 12 \text{ cubed} + 1 \text{ cubed}$ ", said Mr. Sen. "Now tell me, what is 9 cubed?"

Tanu did the multiplication mentally herself and said: "729". She caught on and said, "I get it Dad: $10 \text{ cubed} = 1000$. So, 1729 is the sum of two sets of cubes: first, 12 and 1 and second 10 and 9. It is the smallest number with this property." Tanu marvelled at the genius of Ramanujan and became thoughtful as she remarked, "Do you notice something about Dr. Murthy's passwords? They show a pattern. All of them have a connection with science and numbers."

"Let's see what is the clue for the computer password," Tanu said. On the page were the words: "Computer password: Watt's son stream coloured body". Tanu asked: "Does the password refer to James Watts or his son?"

Mr. Sen said, "You tell me!" and left Tanu to work out the password.

Eagerly, Tanu opened her father's

laptop and looked up James Watts' biography on the Web. James Watts' life was marked by several ups and downs. The Web indicated that Watts had two sons, one also called James and the other Gregory. The information on Watts' sons was minimal. The junior James Watts' efforts had resulted in a steamboat travelling on the Hudson River in America. Tanu felt a pang of thrill as she read this. She called out to her father, "Dad, did you try Hudson in the password?"

"Yes, all of us know how to use search engines on the Web!" retorted Mr. Sen. Tanu was disappointed.

Tanu walked away from the laptop. She thought: "Dr. Murthy's email password had a mathematician's name and a famous number. Let me see if I can guess the number. What on earth did Dr. Murthy mean when he wrote 'stream coloured body'? Should I look for synonyms? 'Body' could stand for 'figure'. A 'stream' is a 'brook'. That does not lead me anywhere."

Tanu had run into a dead-end by now. She reasoned to herself: "No, I have got this wrong. Let me go back to Dr. Murthy: In the password for his email, he indicated 'pi' as 'pie'. Similarly, is there a rhyme for 'stream coloured body'. What does colour mean? I can't think of any rhyming words or similar sounding words."

Frowning, Tanu opened the laptop again and searched for synonyms of the word "colour". The Web showed many words and senses of the word, but none

Tanu searched for the meaning of the word “chromosome” and found that while ‘chroma’ was the Greek word for ‘colour’, ‘soma’ was the Greek word for ‘body’.

of them were useful for Tanu. She started making combinations of the synonyms with the word “body”, but that exercise took her nowhere.

Disappointed, she approached Mr. Sen and asked, “Dad, what were Dr. Murthy’s interests?”

Mr. Sen looked up from the newspaper that he was reading and said: “Dr. Murthy liked talking about science, technological advances and also about its history. During the lunch break, his explanation of the God particle and the Large Hadron Collider had us spellbound. He liked to read about advances in science and technology. I remember him sharing news about advances in genetics, which was a particular favourite of his, being a doctor. He would also talk at length about Greek mathematicians like Archimedes, Euclid and Pythagoras. I suppose he had a fondness for the early Greek pioneers in science. I will miss him and his insights into science,” sighed Mr. Sen.

Tanu prompted her father, “Dad, do you recall him talking about James Watts’ son?” Mr. Sen was still reminiscing about Dr. Murthy when Tanu’s question interrupted his thoughts.

“Who did you say? Watson?” he enquired.

In a flash, Tanu realised what had happened. With a thrill in her voice, she said, “Dad, that’s it. The clue isn’t ‘Watts’ son’, it is ‘Watson’, as in Sherlock Holmes and Dr. Watson.”

Mr. Sen stared at Tanu, surprised and said, “Tanu, you may be on to something here. I don’t think Dr. Murthy was a fan of Sherlock Holmes, but you could be right.”

Immediately, Tanu responded: “Dad, it isn’t the fictitious Dr. Watson, it’s probably the real one: you know, Dr. Watson of the Watson and Crick fame.”

Mr. Sen considered this possibility and nodded, his excitement also growing. “You are right. The first part of the clue refers to Dr. Watson, the American geneticist,” he said.

Tanu opened up her laptop and pointed out a synonym for the word ‘stream’. “Dad, even the second part fits. A ‘stream’ is also called ‘creek’ or, to use a similar sounding word ‘Crick’!” Tanu wrote the words Watson and Crick on the page and continued, “Now, what remains is to find the number indicated by the phrase ‘coloured body’.”

On the laptop, she searched for synonyms for both ‘colour’ and ‘body’. One word caught her attention: ‘chromatic’. “Dad, isn’t ‘chroma’ a Greek word?” Mr. Sen nodded. Tanu mused out aloud, “Considering Dr. Murthy’s preference for Greece, that may mean something. Chroma, chromium, chrome plate But what does that have to do with Dr. Watson and Dr. Crick? What is the link between two giants in genetics and ‘coloured body’ or ‘chrome’?” Changing tactics, she put the words ‘Watson’ and ‘Crick’ and typed ‘chrom’. The search engine prompted her with the string ‘Watson Crick chromosomes’. Immediately, Tanu searched for the meaning of the word “chromosome” and found that while ‘chroma’ was the Greek word for ‘colour’, ‘soma’ was the Greek word for ‘body’. Tanu yelled out in delight: “Dad, the clue refers to ‘chromosomes’!” and took the laptop to Mr. Sen.

Both of them looked at the links related to the meaning of the word ‘chromosomes’ and realised that Tanu had almost cracked the password! “Dr. Murthy would specify the number at the end of the password. If chromosomes are the clue, the number must be 23, the number of pairs of chromosomes in the human cell. So the password is a combination of Watson, Crick and 23,” said Tanu. A proud Mr. Sen nodded and agreed.

“Dad, seeing that the email password was ‘Arch3141’, we can assume that he would have used a similar approach with this password also. Reserving 23 as the last two characters, it means that there are six letters for Watson and Crick. I feel that he

must have used the first 3 letters from each name.”

Tanu wrote the first password as “watkri23”.

“Tanu, remember that he had capitalised the ‘A’ of ‘Archimedes’. He may have followed a similar process here,” said Mr. Sen.

Tanu nodded and wrote “WatKri23” followed by “Watkri23”. The two of them wrote other likely combinations of the three words “Watson”, “Crick” and “23”. The next day, Mr. Sen took Tanu along to the hospital and informed the staff there about how Tanu had almost solved the clues to the password for the computer. Obtaining permission, Mr. Sen booted up Dr. Murthy’s computer. Soon, the computer asked for the password.

Mr. Sen asked Tanu to enter the password. With bated breath Tanu checked that the “CAPS LOCK” key was off and then typed the password “watkri23” with some nervousness. Immediately, the response came: “Password incorrect.”

Mr. Sen said, “Tanu, we have four more attempts. Then the Operating System will allow you to try only after four hours.” Tanu nodded to indicate that she understood and entered “WatKri23” on the second attempt.

Once she pressed the “ENTER” key this time, the password was accepted! Tanu raised her hands up in delight and shouted: “Mission accomplished!”

Mr. Sen looked around and immediately scolded her, “Keep your voice low, Tanu. Remember you are not at home.”

Chastised, Tanu raised an arm in apology and stepped away from the chair in front of the computer. Mr. Sen and Tanu exchanged high-fives.

Indeed, the mission was accomplished, but Tanu felt that a spark had been lit in her. In the last couple of days, she had learnt about the Ramanujan Hardy number, about James Watts and about Dr. Watson and Dr. Crick. A world of knowledge beckoned her. As she headed back, she made a resolution that she would learn more about genes and about the life of Ramanujan. It was a happy and curious Tanu who reached home that evening.

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ARATI ARVIND KAREKATTE



SMILE

IN his very enlightening and entertaining column in *The Indian Express*, writer Ranjit Lal wonders as to which traits to take a pick from animals to be superhuman: the vision of an eagle, hearing of an owl, strength of an elephant, acceleration of a cheetah, the ever-changing chameleons – and the list goes on.

How about a smile? Which animals can we look for – apes may be. No, animals do not smile as humans. While a dog's face may appear to be smiling to us, the dog is probably not feeling an emotion in the same way that we as humans do.

"They don't smile, they grin, daadi" – wisdom from my seven-year-old grandson. So, there is a difference between a smile and a grin, which even a seven-year-old can tell. Add to this laugh, giggle and chuckle -- each conveys joy, love, mock, guilt, smirk, deceit, even lying. More than seventeen types of smiles have been described by Paul Ekman (the world's leading expert on facial expressions) in his 1985 book *Telling Lies*. Wonder if he ever tried classifying the enigmatic, one and only, 'Mona Lisa Smile'. I, for one, am not even sure if she is smiling at all.

Laugh, giggle and chuckle — each conveys joy, love, mock, guilt, smirk, deceit, even lying. More than seventeen types of smiles have been described.



Do animals smile?

All this is to say that the human smile is much more than a mere show of our pearls. We're a naturally smiling species. A happy smile is a true sign of enjoyment.

For instance, imagine you are in a crowded place. Your eyes spot a long-lost dear friend. Your hands clasp each other's... a small act of happiness indeed! But, an array of reactions follows.

Your sensory corridors are excited and all this emotional data is funneled into your brain's left, front-temporal region, which then sends a glow on to the surface of your face; here, two all attentive muscles are stirred into action.

The muscle residing in the cheek (called zygomatic major) pulls the lips upward and the other muscle around the eye socket (called orbicularis oculi) squeezes the outside corners into the shape of a crow's foot. Mind you, all this

happens within four seconds and your friend witnesses a happy smile on your face and reciprocates by smiling in return.

Other muscles can copy a smile but only this peculiar dance of the two muscles produces a genuine expression of positive emotion. Most consider it the only indicator of true enjoyment.

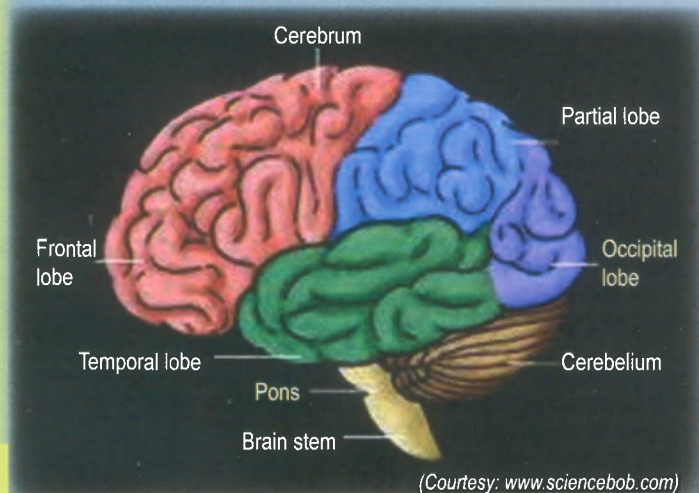
Psychologists call this a "Duchenne smile" named after French anatomist Guillaume Duchenne, who studied emotional expressions by stimulating various facial muscles with electric currents. It was so painful that volunteers failed to turn up; it is said, that he had to perfect his technique on the severed heads of executed criminals.

He wrote that the cheek muscle can be ordered into action, but only the "sweet emotions of the soul" force the muscles around the eye to contract. "Its inertia in smiling unmask a false friend," he wrote. This was in 1862. Duchenne very well knew that a mouth can be manipulated into a smile more easily than the eyes.

Shakespeare's Hamlet, for example, says "one may smile, and smile, and be a villain". So people can deduce useful information from smiles and what is more, they can use this knowledge to direct their own behavior.

Incidentally, a genuine smile and a false, social 'Say-Cheese-Smile' can be caught on modern imaging techniques called functional magnetic resonance imaging (fMRI). fMRI is based on the same technology as magnetic resonance imaging (MRI) – a non-invasive test that uses strong magnetic field and radio waves to create detailed images of the

THE HUMAN BRAIN



More than 10 billion cells

More than 100 trillion connections

More than 100 Neuro-transmitters

(Courtesy: www.sciencebob.com)



Left: Facial expressions in blind participants and their relatives



Wonder if Paul Ekman ever tried classifying the enigmatic, one and only, 'Mona Lisa Smile', if she is smiling at all.

body. Instead of creating body-images of organs and tissues like MRI, fMRI looks at blood flow in the brain to detect areas of activity, captured on a computer – telling you how the brain works.

The technique works on a principle that oxygen-poor hemoglobin in the blood is affected differently by a magnetic field than the oxygen-rich hemoglobin. Brain tissue that is more active because more neurons are firing will need more blood flow and therefore blood flow can be used to deduce relative brain activity. So when a subject has a Duchenne smile or a false smile on his face, the fMRI will show which parts of the brain are involved in each of these tasks.

In recent times, researchers at the Universities of California and Wisconsin have confirmed this unique link between positive emotions and the true Duchenne's smile. They captured precise muscular coordinates behind 3000 facial expressions in their Facial Action Coding System (FACS), by attaching electrodes to the heads of the participants while seeing a series of short films – happy and sad. FACS is a common standard to systematically categorize the physical expression of emotions. Movements of individual facial muscles are programmed by FACS from slightly different to sudden changes in facial appearance.

In 1990, they concluded: "Clearly the Duchenne smile...is a better sign of enjoyment than other kinds of smiles."

A smile is also one of the most basic, biologically uniform expressions of all humans. Paul Ekman discovered that smiles are cross-cultural and have the same meaning in different societies. Again, the ability to produce a Duchenne smile is packed off equally between men and women but men say they smile less than women. Behavioral scientists agree. Broadly speaking, it seems to be true.

Smiling is evolutionarily contagious and we have a subconscious innate drive to smile when we see one, even if it comes from a stranger.

Smiling is really good for us. What is more, it makes you look attractive. And a recent fMRI study found that viewing attractive faces activates the brain's orbitofrontal cortex – a region known to be involved in processing sensory rewards. So can we say that a 'winning' smile is hard-wired into our brain?

Indeed, smile seems built into our nature. As early as 1872, Sir Charles Darwin proposed that facial expressions are universal products of human evolution rather than cultural teachings, in his book *The Expression of the Emotions in Man and Animals*. The zygomatic major mentioned above has a long evolutionary history, says expression researcher Jeffrey Cohn of the University of Pittsburgh. He further goes on to say that, "There is good evidence that the motor routine involved in smiling is inborn; the hardware is there."

It is not surprising then that newborns can dole out and interpret facial expressions with great precision. Have you ever seen, for instance, an infant, around say 9-months old, offering a false smile to an approaching stranger while reserving a genuine toothless, adorable Duchenne smile for its own mother? In fact, 3-month old babies can react to a mother's changing moods.

Three-dimensional ultrasound technology now shows that developing babies appear to smile even in the womb. After they're born, babies continue to smile – initially mostly in their sleep; even blind babies smile in response to the sound of the human voice, once again adding to the notion that smiling is innate in us and is not copied from social encounters.

Individuals blind from birth could not have learned to control their emotions in a way through visual learning, so there must be another mechanism, observes researcher David Matsumoto. He suggests something in our evolutionary history is responsible for the built-in responses. To separate the impact of genetic inheritance from social copying/mimicry, scientists looked at people who were born blind. Expressions are similar between blind participants (below) and their normal relatives (above) as seen in the picture below (Gili Pelag. et al., 2006).

Are we suggesting a role for genes here? 'From sneers to full-blown smiles, our facial expressions are hardwired into our genes', suggests a new study. The next step then is to try and find the genes responsible. Such information would be useful in the study of disorders in which facial expression is impaired.

Dimples, another added attraction, too are inherited and a single gene is involved here. When a person smiles, the shorter muscle on the face pulls the facial skin; this, in turn, creates a slight depression in the skin leading to dimples.

So here is a SMILE for you, – for a happier and a healthier YOU.

Dr. Arati Arvind Karekatte retired as Scientific Officer at TIFR, Mumbai. Earlier she worked at MRC, Cambridge and at Yale University for her PhD work and also taught in the Department of Biotechnology, University of Pune (1994-1998). She has done her PhD work in Developmental Genetics, *Drosophila melanogaster*, under the guidance of Prof. P. Babu and Prof. Obaid Siddiqui. Address: 24A, Lantana Gardens, Bavdhan Pashan-NDA Road, Pune-411021, Maharashtra. Email: tiara14@gmail.com



The Mirror

I wanted to try something. I paced towards the radioactivity chamber, went up to the mirror. I could see myself walking towards it. I went straight to it and took my gloves off, pointed a finger and slowly touched the mirror. Suddenly I saw ripples being formed in it. It was an amazing moment

"It was a pretty tiresome day," I said to myself as I walked towards my apartment. I had been working all day on the new project assigned to me and was really close to packing it up.

I entered the room and went straight to my secret closet under my bed and pressed a few key-like wooden pieces and the whole tile opened like a lid. "I'm pretty smart, ain't I?" I said to myself. I had created that closet to protect my valuables, especially the classified project I've been working on. I closely observed my calculations and my theories as I lay on my couch.

I was one of the leading scientists of the century. My recent project was to search the properties of an element, recently synthesized by my team, whose existence was denied by many other intellectuals. My argument was that this

element (also called supremium) could be used for creating a wormhole!

We created a thin sheet of supremium that looked like a mirror. We stabilised its structure and we were going to test it the next day but there was one problem that it actually acted like an ordinary mirror until and unless it was brought into contact with a highly evolved carbon-based life form.

We were not sure what evil it might bring upon us. But I had to test my theory.

I went early to the lab, because I wanted to try something. I paced towards the radioactivity chamber, went up to the mirror. I could see myself walking towards it. I went straight to it and took my gloves off, pointed a finger and slowly touched the mirror. Suddenly I saw ripples being formed in it. It was an amazing moment (as I was the only organic thing that had ever touched it).

As the ripples settled, I saw my own image smiling at me! I was perplexed at the

horrid sight. And then it said, "Welcome to my world, buddy"!

"How can you talk?" was my first question.

"Calm down sir. I will tell you everything I know," he said. "We are images of the organic matter present in your world. Everyone has a separate one for themselves. We are bounded by some rules which I think are just guidelines meant to protect us from human knowledge. We are not supposed to talk to humans and we ought to do what they do when they look at any mirror. We follow them everywhere they go. Whatever they see in mirrors is only the reflection of their own world. Rest of our world is just a void. But you my dear sir, was able to open a portal between the two worlds. Just look back where you are standing."

I was already losing my mind but when I looked behind I was completely out of my wits. What I saw was just pieces



I was literally flying at this moment. How could I forget? I gave my name voluntarily to touch that supremum mirror. I had actually signed a document that said I can't back out from it and I would be responsible if I died during the project.

of the world that could be seen through a mirror. The rest was just nothingness! I turned back and shouted to bring me out of that hell, tried to bring those bloody ripples back in that bloody mirror.

He said with a smile on his face, "I've tried it too but nothing happens until both of us touch it. Now it's your time to rot in this hell and mine to roam free in your world. You fall and I rise, doctor Frankenstein! Behold your own monster taking your place with your own good eyes! Now you will follow me and you will do exactly what I do. Master, you've become my slave!"

I gained my sanity and thought quickly what to do in such a situation. But I was unable to think anything. Suddenly I felt a thud and I turned back and started to move towards the false gate of the false radioactivity chamber. I tried to stop myself but couldn't. I was doing the same thing as my image in my world was doing!

And suddenly, I stopped and looked back at the mirror. I could see him smiling over his shoulder. Then he went away and

so did I, in the nothingness that followed the gate. I thought to myself, "What've I done...."

I watched him walk past some mirrors that I used to comb my hair when I went to the lab. I was crying inside but I had to smile as he was smiling too. I guess that was his mockery. But suddenly I saw some figures appearing towards me. I couldn't see the faces clearly as they vanished in the nothingness from time to time.

But finally I saw a familiar face. It was the director of the department who had allotted me this project! I wanted to curse this man but at this moment he was my last resort. He came to the other me and said, "Good morning, my boy! Roaming alone in these halls by your own. Let's get started! Today's the big day! We will start the procedure without wasting our precious time!"

I was literally flying at this moment. How could I forget? I gave my name voluntarily to touch that supremum mirror. I had actually signed a document that said I can't back out from it and I would be

responsible if I died during the project.

I could hear my image resisting but they dragged me to the chamber and made the image touch the mirror. He gave a loud cry as we both touched the mirror together. The ripples were created and I saw nothing in the mirror. As soon as the ripples vanished, I saw that I was again in the real world.

The director said with excitement, "Did it work? Did it actually work?"

I gathered my emotions and said, "No sir, it was my mistake to even consider such an idea. Of course, it didn't work! Let's melt this mirror and synthesize something useful. And yes, make sure nobody touches it. It's radioactive."

Saying this I started walking towards the door. I stopped and smiled over my shoulder.

Shivom Chauhan is a Class XII student. Address: 4/159 Kela Nagar, Aligarh, UP-202001; Email: chauhanshivom@yahoo.in

Prize Puzzle

A DAY OR YEAR

Imagine you are dropped on to the surface of Venus in a safe transparent capsule. Then you are given a choice: You will be left there for either for a day or a year. If you choose to stay a day, you get 1 million rupees. If you choose to stay a year, you get 2 million rupees. Either way, you will have sufficient food and water and are provided with a temperature that is a constant 70 degrees Fahrenheit. What will be your choice?

ANSWER: _____



There are three prizes of Rs 500/- each for three correct entries. In case of a large number of correct entries, the prize winners will be selected through a draw of lots. The decision of the Editor, *Science Reporter* will be final.

Send your entries to:

Puzzle Corner

Editor, *Science Reporter*

National Institute of Science Communication & Information Resources (NISCAIR)

Council of Scientific and Industrial Research (CSIR)

Dr KS Krishnan Marg, Pusa Campus

New Delhi-110012

**Last date for the
entries to reach us:
05-10-2015**

Name :

Address :

..... Pin code:

Age : Email: Sex:

Occupation : ☐ Student ☐ Housewife ☐ Teacher ☐ Professional ☐ Retired ☐ Other

Educational level : ☐ Primary ☐ Secondary ☐ Graduate ☐ Postgraduate

- Please fill up the questionnaire at the back
- You can send your answers on a photocopy of this page as well.

UNSCRAMBLE THE ANIMALS

Given below are names of 15 animals in scrambled form. Unscramble them to reveal their identity

1. DRBI
2. OENDYK
3. GLOILARTA
4. EHSOR
5. OLIN
6. MYOEKN
7. EEB
8. RGFO
9. ORCDCIELO
10. POLNIHD
11. LARLIGO
12. EMSUO
13. EGTRI
14. ABRITB
15. TPNLEHEA



- | | | | |
|-----------|-----------|-----------|-----------|
| 1. _____ | 2. _____ | 3. _____ | 4. _____ |
| 5. _____ | 6. _____ | 7. _____ | 8. _____ |
| 9. _____ | 10. _____ | 11. _____ | 12. _____ |
| 13. _____ | 14. _____ | 15. _____ | |

DISEASE SUDOKU

Fill the grid below with the names of Four Viral Diseases and Five Bacterial Diseases given in such a manner that every 9x9 box, every column and row accommodates the names of four viral diseases and five bacterial diseases, without any repetition. The names of viral diseases should come in the shaded boxes only.

Polio			Plague		Measles		Cholera	
		AIDS						Tetanus
			Leprosy				Measles	
Measles			Anthrax					
			AIDS			Leprosy		
	Leprosy						AIDS	
		Tetanus			Cholera			
							Tetanus	
Rabies				Leprosy			Polio	

Contributed by Harekrushna Jena (Student), M.Phil. in Biosciences, P.G. Department of Biosciences & Biotechnology, Fakir Mohan University, Balasore-756020, Odisha; Email: jena_harekrushna@yahoo.in

Solutions to the puzzles published in the July 2015 issue

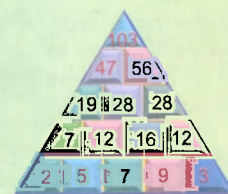
Prize Puzzle: SUICIDE PUZZLE

The man stood on a slab of ice. Slowly as the slab melted it left behind a puddle of water only.

DOES THIS SOUND GREEK TO YOU

tri-	Three	Triplet
CEREBRO	BRAIN	Cerebral palsy
POD	FOOT	Tripod
CEPHALO	HEAD	Encephalitis
DERM	SKIN	Dermatitis
ANTHO	FLOWER	Anthocyanin
BARO	HEAVY	Barometer
ACTINO	RAY	Actinomyces
ARTHRO	JOINT	Arthropod
CARBO	COAL	Carbon
HELI	SPIRAL	Helical
NECRO	CORPSE	Necrotic tissue
ALBO	WHITE	Albino
DEXTRO	RIGHT	Dextrorotatory
ISO	EQUAL	Isotonic
PSEUDO	FALSE	Pseudopodia
NEMA	THREAD	Nematode
CILI	EYELASH	Cilia
CARN	MEAT	Carnivores
TRANS	ACROSS	Transgenic plants

NUMBER TRIANGLE

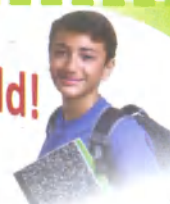


The prizewinners based on the draw of lots from among the correct entries are:

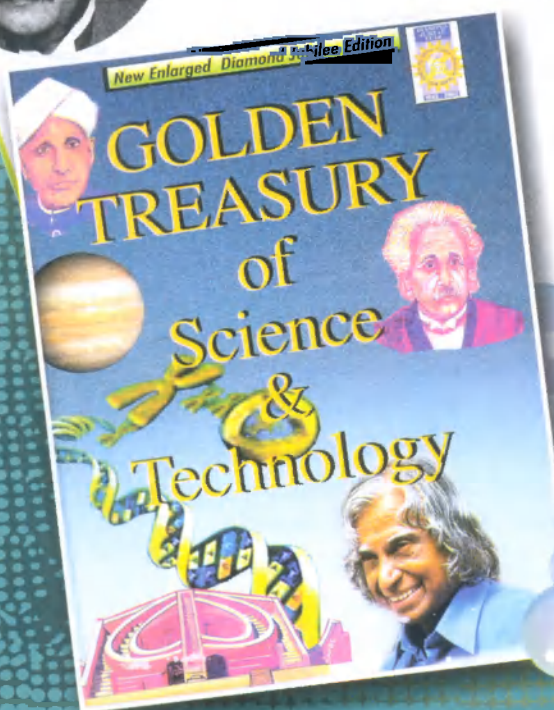
- **Siddhi Sanjay Kale**,
B-12 Maurya Garden, Kothrud,
Pune-411038, Maharashtra
- **Abhishek Kumar Pandey**,
Sector I C, Qtr No. 826, Bokaro
Steel City, Dist. Bokaro,
Jharkhand-827001
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Congratulations all the winners!

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THIS MONTH IN SCIENCE: **SEPTEMBER**

1 September

1865, first antiseptic surgery performed by Dr. Joseph Lister, a British surgeon.

1887, patent issued for invention of the lateral-cut, flat-disk gramophone to Emile Berliner.

1997, discovery of a new sub-atomic particle "exotic meson" announced.

2 September

2007, geosynchronous satellite launch vehicle (GSLV-FC04) launched by India. INSAT-4CR successfully placed in orbit from the Satish Dhawan Space Centre.

3 September

1905, Carl David Anderson, American physicist who shared (with Victor Francis Hess of Austria) the Nobel Prize for Physics in 1936 "for his discovery of the positron, or positive electron, the first known particle of antimatter", was born.

1976, the unmanned spacecraft "Viking II" landed on Mars and took the first pictures of the surface of Mars.

4 September

1888, first roll-film camera Kodak patented by George Eastman.

1906, patent issued to Robert Eugene Turner of Norfolk, Virginia, for his invention of a "Type Writing Machine (typewriter)" (U.S. No. 830,115).

2006, vaccine for a type of meningitis offered for the first time in Great Britain for all babies at two, four and 13 months as part of the national childhood immunisation programme.

5 September

1977, NASA launched Voyager 1 from Cape Canaveral, Florida.

6 September

1891, first operation to suture the pericardium (the fluid sac surrounding the heart muscle) took place at the City Hospital in St. Louis. Henry C. Dalton, professor of abdominal and clinical surgery at the Marion Sims College of Medicine repaired a 2" tear of the pericardium of James Cornish, a 22-yr-old black man, caused by a stab wound in a fight.

1892, Sir Edward Victor Appleton, English physicist who was awarded the 1947 Nobel Prize for Physics "for his discovery of the Appleton layer of the ionosphere", was born.

1978, the production of human-type insulin by a strain of E. coli bacteria announced, it was genetically engineered after months of creative use of gene-splicing techniques.

7 September

1888, baby incubator was first used in the U.S. to care for an infant at State Emigrant Hospital on Ward's Island, New York.

8 September

1918, Sir Derek Harold Richard Barton, an English chemist, who shared (with Norwegian Odd Hassel) the 1969 Nobel Prize for Chemistry "for the study of the 3-D geometric structure of complex molecules", was born.

9 September

1945, the first "bug" in a computer program discovered by Grace Hopper.

10 September

1984, DNA fingerprinting discovered in Leicester, England, by Alec Jeffreys as X-ray films of his tests first revealed the possibility.

11 September

1935, Gherman Titov, the first man to spend a day in space, was born. He went in Vostok-2 spacecraft on 6 August 1961 and remained in space for 25 hours and 18 minutes.

12 September

1959, Luna 2, an unmanned Soviet lunar probe was the first spacecraft to strike the Moon.

1992, the crew of the Shuttle Endeavour included the first African-American woman in space, Mae C. Jemison, as a Science Mission Specialist aboard Endeavour.

13 September

1898, Reverend Hannibal Williston Goodwin issued a patent for his invention of "nitrocellulose transparent flexible photographic film pellicles." (U.S. No. 610,861).

1977, the Shuttle Enterprise successfully made its second of five free flights as

part of the Shuttle Approach and Landing Tests, at NASA's Dryden Flight Research Facility, California.

14 September

1959, Luna 2 the first space probe to strike the moon crashed east of the Sea of Serenity.

15 September

1917, the term "bacteriophage" ("eater of bacteria") coined by Dr. Félix d'Hérelle in the French Academy of Sciences.

1929, Murray Gell-Mann, American theoretical physicist who predicted the existence of quarks, was born. He was awarded the 1969 Nobel Prize for Physics "for his contributions to particle physics".

1998, rings around planet Jupiter declared to be made of dust from the impacts of cosmic bodies that crashed into Jupiter's moons.

16 September

1662, the first recorded astronomical observation of the first Astronomer Royal was John Flamsteed's observation of a solar eclipse from his home in Derby at the age of sixteen.

17 September

1683, Dutch scientist Antonie van Leeuwenhoek reported to Royal Society his discovery of microscopic living animalcules (living bacteria).

1953, at the Ochsner Foundation Hospital in New Orleans, Louisiana, Carolyn Anne and Catherine Anne Mouton were the first Siamese twins to be successfully separated by surgery.

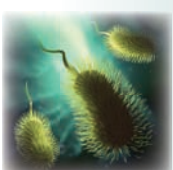
18 September

1907, Edwin Mattison McMillan, an American nuclear physicist who shared the Nobel Prize for Chemistry in 1951 (with Glenn T. Seaborg) "for his discovery of element 93 (Neptunium)", was born.

19 September

1838, Ephraim Morris patented the railroad brake.

1848, Hyperion, the moon of Saturn discovered by Bond of the US and Lassell of England.



THIS MONTH IN SCIENCE

1957, underground nuclear explosion detonated by USA in Las Vegas, Nevada.

20 September

1892, wire glass patented by Frank Schulman. Wire glass, as the name suggests, is simply a wire mesh inserted during the plate glass manufacturing process to create a single monolithic glass with properties useful where fire safety requirements apply.

1904, first circular flight in an airplane made by Orville Wright at Huffman Prairie, near Dayton, Ohio.

2004, EDUSAT by ISRO, India's first exclusive satellite for educational facilities, launched from Satish Dhawan Space Centre, Sriharikota, into a Geosynchronous Transfer Orbit.



21 September

1875, Thaddeus S.C. Lowe, inventor and scientist, patented a process for water gas production of "illuminating or heating gas."

2003, the U.S. NASA Galileo space probe ended its eight-year mission to Jupiter as planned.

22 September

1922, Chen Ning Yang, Chinese-American theoretical physicist who shared the 1957 Nobel Prize for Physics (with Tsung-Dao Lee) "for a ground-breaking theory", was born.

1959, Saul Perlmutter, an American astrophysicist who shared (with Brian P. Schmidt and Adam G. Riess) the 2011 Nobel Prize in Physics "for the discovery of the accelerating expansion of the Universe through observations of distant supernovae", was born.

23 September

1930, Johann Ostermeyer of Aethenber, Germany, patented his "Improvements in flash lights used for photographic purposes." (UK No. 324,578).

1953, the Water Displacement 40th test (WD-40) was invented and recorded for the first time in the Rocket Chemical Company's logbook by Norm Larsen, for a lubricating penetrating oil intended to displace water for rust prevention.

24 September

1852, a new invention, the dirigible - a semi-rigid airship was demonstrated in a flight from Paris to Trappe

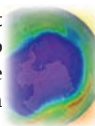


1909, Thomas M. Flaherty filed for a U.S. patent, with an idea for a "Signal for Crossings".



1960, first nuclear-powered aircraft carrier, USS Enterprise, was launched in Newport, Virginia.

2006, NASA recorded the largest ozone hole in the atmosphere to date, as measured by the Ozone Monitoring Instrument on NASA's Aura satellite.



25 September

1820, Francois Arago announced that a copper wire between the poles of a voltaic cell, could laterally attract iron filings to itself.

1866, Thomas Hunt Morgan, American geneticist and zoologist famous for his experimental research with the fruit fly by which he established the chromosome theory of heredity, was born.

1956, the world's first transatlantic telephone cable system began operating (Clarenville, Newfoundland to Oban, Scotland).



1974, scientists first reported that Freon gases released from aerosol spray cans were destroying the ozone layer.

26 September

1849, Ivan Petrovich Pavlov, Russian physiologist awarded the Nobel Prize in Medicine or Physiology in 1904 for "in recognition of his work on the physiology of digestion, through which knowledge on vital aspects of the subject has been transformed and enlarged", was born.

1886, Archibald Vivian Hill, British physiologist and biophysicist who received (with Otto Meyerhof) the 1922 Nobel Prize for Physiology or Medicine "for discoveries concerning the production of heat in muscles", was born.

27 September

1825, George Stephenson's Stockton to Darlington railway, the first railway in the world designed for steam locomotion was opened.



1910, patent for the Production of Ammonia was issued to Fritz Haber and Robert Le Rossignol (U.S. No. 971,501).

1925, Sir Robert Edwards, who became the sole recipient of the Nobel Prize in Physiology or Medicine, in 2010, "for the development of in vitro fertilization",

was born.

2003, SMART-I, the first European mission in the moon was launched, aboard an Ariane-5 rocket from the European Space Agency's launched in Kourou, French Guiana. SMART stands for Small Missions for Advanced Research in Technology.



28 September

1858, Donati's comet (discovered by Giovanni Donati) became the first to be photographed.

1860, Paul-Urich Villard, a French physicist and chemist who in 1900 identified a third kind of natural radiation, later called gamma rays, was born.



29 September

1891, Thomas A. Edison was issued U.S. patent No. 460122 for a "Process of and Apparatus for Generating Electricity" and No. 460123 for a "Phonogram-Blank Carrier."

1920, Peter Dennis Mitchell, British chemist who won the 1978 Nobel Prize for Chemistry, "for helping to clarify how ADP (adenosine diphosphate) is converted into the energy-carrying compound ATP (adenosine triphosphate) in the mitochondria of living cells", was born.

1962, Alouette-I, the first Canadian satellite was launched to study the ionosphere.

1988, space shuttle Discovery blasted off from Cape Canaveral, Fla., marking America's return to manned space flight following the Challenger disaster.



1997, PSLV-CI, India's first operational polar satellite launch vehicle launched from Sriharikota Range.

30 September

1881, the Godalming town council in Surrey, England, voted to have the world's first public electricity supply.

1902, the "making of cellulose esters" (Rayon) was patented by William H. Walker, Arthur D. Little and Harry S. Mork of Massachusetts (U.S. No. 709922).

1929, an early manned rocket-powered flight was made by German auto maker Fritz von Opel

1982, H. Ross Perot and Jay Colburn completed the first circumnavigation of the world in a helicopter, the Spirit of Texas.

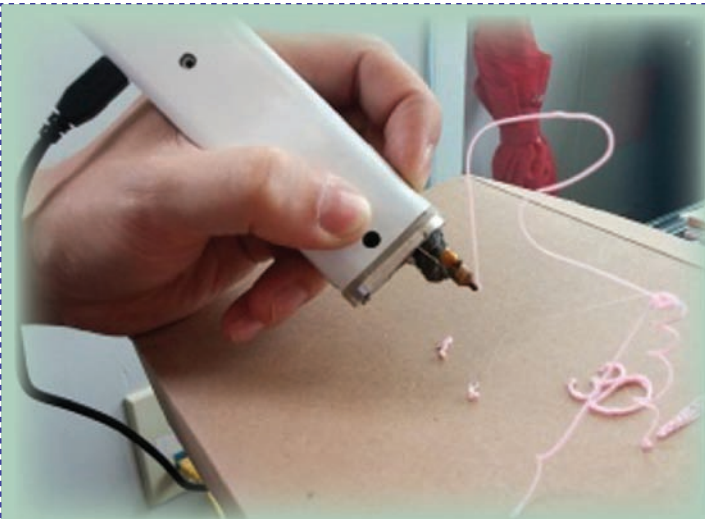
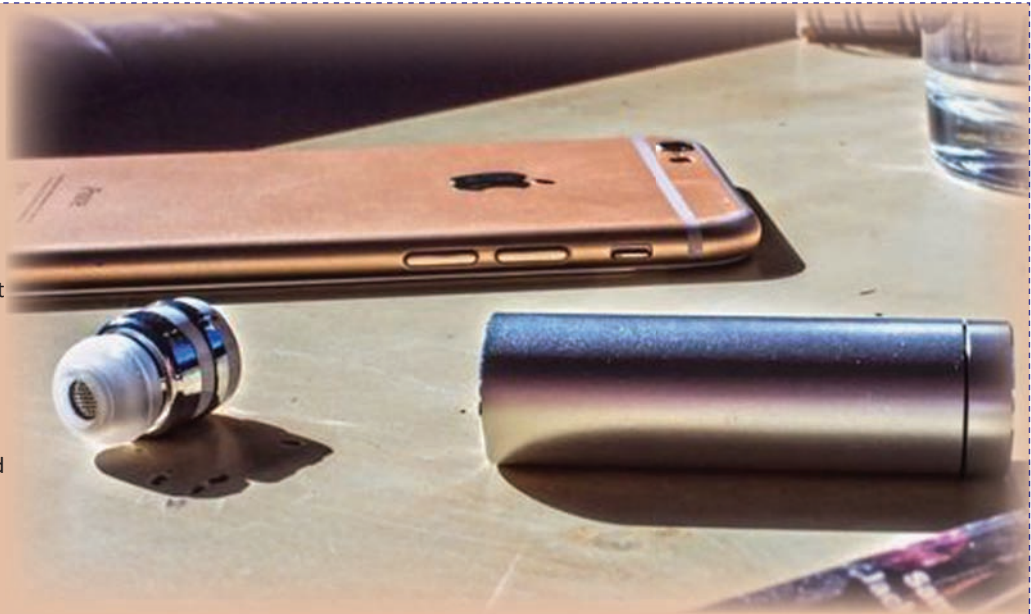
Compiled by Vijendra Kumar, Research Intern, National Science Library, CSIR-NISCAIR, SV Marg. Email: vkumar1s@vnu.ac.in

THE DOT

Dot is the world's smallest Bluetooth headset, measures only 13.8 by 21 mm. The Dot is made up of one tiny earbud and includes a single multi-function button. It is completely wireless, sweat resistant, weighs only 3.5 grams and is available in a stereo version (two earbuds) also. This tiny headset is made up of lightweight aluminium and durable polycarbonate material. It can connect to up to 8 devices at once and has a standby time of 80 hours. Dot uses

the latest CVC audio enhancement technology to generate crystal clear sound from a compact design. To reduce size, Dot utilizes a space-saving wireless charging instead of a large bulky charging port.

(androidcommunity.com)



3D SIMO MINI PRINTING PEN

The 3D Simo Mini is a 4-in-1 maker device that can 3D draw, solder, burn and cut. This palm sized maker tool is equipped with four interchangeable nibs that allow it to cut foam, burn and engrave wood as well as 3D draw using plastic filament and solder electronic components together. The mini also communicates via a Bluetooth with a free mobile app that is used to control the functions and temperature on the device. It can handle a wide range of popular 3D printing materials (1.75mm width strings) including laybrick, ABS, PLA, PETG, HIPS, FLEXI and laywood. The device is powered by a clip-on battery pack with a 2000 mAh battery inside.

(www.notey.com)

VP-10 POCKET VOICE RECORDER

The VP-10 is a pocket size digital voice recorder for capturing lectures, conferences and business meetings. It is packed with 4GB internal storage which is enough for 1620 hours of recording before having to download files to computer. It has omni-directional stereo microphones



in order to capture sound from your pocket, clipped to notebook or anywhere else. It is powered by a single AAA battery and has a battery life of 50 hours recording and 29 hours of playback time. The device records to PCM, WMA or MP3 file formats. Equipped with Anti Rustle Filter technology, the device is able to differentiate between a voice and a rustling sound and effectively suppresses the noise to leave a clear, high quality voice recording.

(www.adorama.com)



A NEW FINGERPRINT SCANNER TECHNOLOGY

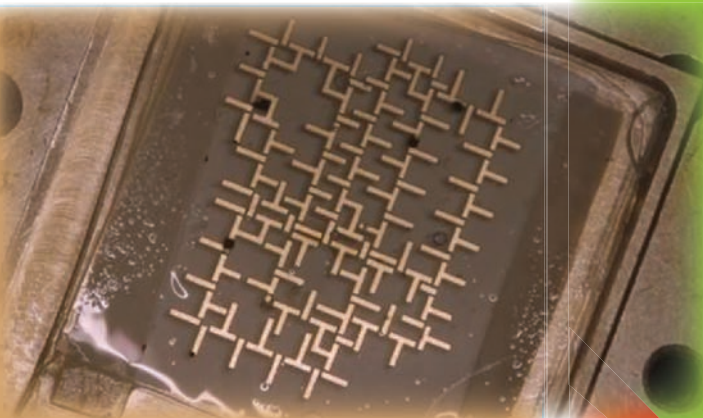
A new self-contained fingerprint authentication technology will reduce the risk of data being compromised by hardware hacks or system malware on the connected host computer. The match-in-sensor technology based on a system on chip architecture can sense a fingerprint that a user is holding over a scanning surface. Then it matches the print to a database that is stored in the device itself. The device with an in-sensor microprocessor allows all input and output functions such as fingerprint image enrollment, pattern storage, and biometric matching. The fingerprint data is not communicated with an external processor as it is match-on-host authentication.

(www.engadget.com)

COMPUTER WORKS BY WATER DROPLETS

Bioengineers have developed a synchronous computer processor that operates using the unique physics of moving water droplets, instead of typical electrons. The computer is constructed with a series of very small "T" and "I" shaped pieces of metal arranged to alter the shape of a magnetic field generated by electromagnetic coils that surround the machine. Acting like a magnetic clock, the magnetised drops of liquid can then be controlled to move around in specific patterns. The 1s and 0s of the binary code are represented by the presence or absence of a water droplet and the clock ensures that all the droplets move in perfect synchrony, so the system can run without errors.

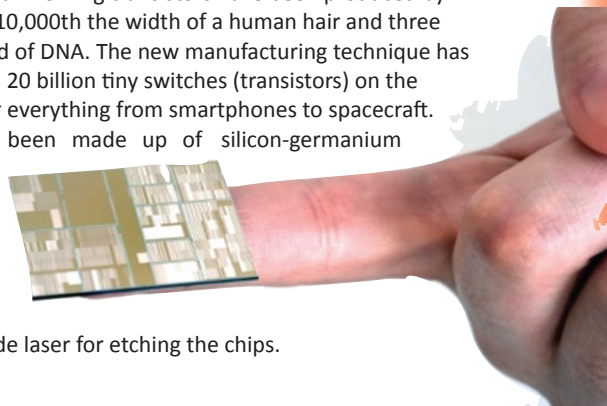
(www.wired.co.uk)



7 NM NODE TEST CHIPS

The first 7 nm node test chips with working transistors have been produced by researchers, which are about 1/10,000th the width of a human hair and three times the width of a single strand of DNA. The new manufacturing technique has the potential to place more than 20 billion tiny switches (transistors) on the fingernail-sized chips that power everything from smartphones to spacecraft. The transistor channels have been made up of silicon-germanium (SiGe) for the first time to conduct electricity rather than pure Si. Also, new technique of EUV (Extreme Ultraviolet) lithography is used in the chip making process rather than currently used argon fluoride laser for etching the chips.

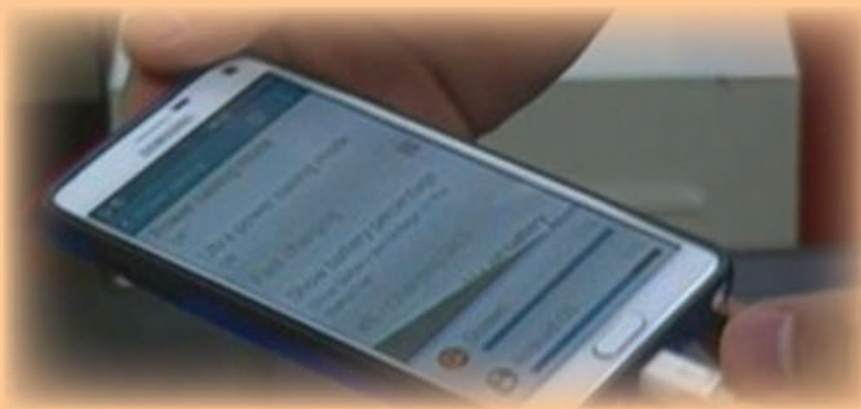
(www.extremetech.com)



A WIRELESS CHARGING TECHNOLOGY CHARGES MULTIPLE DEVICES

A new wireless omnidirectional charging technology has been developed by scientists that is capable of charging multiple devices at once and at a distance of up to 0.5 m from the power source. This effective system delivers 30 watt of charging power which is capable of charging 30 smartphones with power capacity of 1 watt each or 5 laptops with power capacity of 2.4 watt each simultaneously. The dipole coil resonance system (DCRS) works by inducing magnetic fields to transmit the power from the charging pad to the device. The mobiles or laptops will be charged as long as they are within the wireless power zone or Wi-power area irrespective to their positions, which seem similar like a Wi-Fi zone.

(www.geek.com)



Water

REETIKA SINGH

- How much part of the earth approximately is covered with water?
(a) 71% (b) 50% (c) 30% (d) 80%
- Which day is celebrated as World Water Day?
(a) 22nd April (b) 22nd March (c) 21st March (d) 22nd May
- Which form of water is considered as most pure?
(a) River water (b) Tube well water
(c) Sea water (d) Rain water
- Maximum density of water is at:
(a) 20°C (b) 40°C (c) 4°C (d) 100°C
- Boiling point of water is normally (at sea level):
(a) 200°C (b) 40°C (c) 50°C (d) 100°C
- Percent of freshwater on the earth is about:
(a) 97.5% (b) 90% (c) 5% (d) 2.5%
- Maximum percentage of fresh water is present in the form of:
(a) Ground water (b) Glaciers (c) River (d) Other form
- What approximate percentage of available water is used for irrigation?
(a) 83% (b) 90% (c) 95% (d) 75%
- Which of the following organizations is working for water management?
(a) National Commission for Integrated Water Resources Development
(b) National Commission for Entire Water Resources Development
(c) National Environmental Engineering Research Institute
(d) None of the above
- What percentage of total fresh water is present in the form of glaciers?
(a) 68.9% (b) 60.9% (c) 65% (d) 62%
- Due to presence of large percentage of water, earth is known as:
(a) Water planet (b) Green planet
(c) Blue planet (d) Yellow planet
- What percentage of total fresh water is present in the form of ground water?
(a) 40% (b) 35.5% (c) 35% (d) 30.8%
- Which year was celebrated as International Year of Water Cooperation (IYWC) by United Nations?
(a) 2012 (b) 2013 (c) 2014 (d) 2010
- Which year was announced as water conservation year in India?
(a) 2011-2012 (b) 2013-2014
(c) 2015-2016 (d) 2014-2015
- A human body contains water about:
(a) 35% (b) 51% (c) 60% (d) 82%
- Boiling point of water on the top of Mount Everest is:
(a) 60°C (b) 68°C (c) 58°C (d) 100°C
- The boiling point of water normally depends on
(a) Quality of water (b) Barometric pressure
(c) Amount of water (d) All of the above
(e) None
- Study of the movement, distribution, and quality of water throughout the Earth
(a) Hydrology (b) Hydrography
(c) Hydrogeology (d) Limnology
- The study of the distribution of water is
(a) Ecohydrology (b) Hydrology
(c) Hydrogeology (d) Hydrography
- The study of the distribution and movement of groundwater is
(a) Hydrology (b) Hydrography
(c) Hydrogeology (d) Ecohydrology
- pH of pure water is
(a) 0 (b) 14 (c) 7 (d) 1
- Martin Strel is known as
(a) Water man (b) Sea man
(c) Big water man (d) Big river man
- Limnology is study of which type of ecosystem
(a) Water (b) Fresh water
(c) Saline water (d) Ocean water
- Lake in which surface temperatures never go above 4°C, is known as
(a) Ice lake (b) Cold lake
(c) Polar lake (d) None of the above

ANSWERS: 1) a 2) b 3) d 4) c 5) d 6) d 7) b 8) a
9) a 10) a 11) c 12) d 13) b 14) c 15) c 16) b
17) b 18) a 19) d 20) c 21) c 22) d 23) b 24) c

Contributed by Reetika Singh, Research Scholar, Department of Botany, Banaras Hindu University, Varanasi-221005, Uttar Pradesh:
Email: reetikasingh.bhu@gmail.com

Nuclear Medicine & Radiation

DEVI D. PANDEY & NIDHI PANDEY

1. Which isotope is used in Thyroid Cancer Treatment?

- (a) Iodine-131
- (b) Strontium-89
- (c) Thallium-201
- (d) Oxygen-18

2. PET (Positron Emission Tomographic) Scanning is being effectively used in measurement of regional cerebral blood volume, blood flow, metabolic rate for glucose and oxygen in humans. Which of the following radioisotopes is used in PET-imaging technique to label tracers?

- (a) Carbon-11 & Fluorine-18
- (b) Nitrogen-13 & Heavy Water
- (c) Oxygen-15 & Carbon-14
- (d) Iron-59 & Phosphorus-32

3. Institute of Nuclear Medicine & Allied Sciences (INMAS-DRDO) is a famous institute for development of radioprotectors and nuclear medicine research, situated in:

- (a) Lucknow
- (b) Delhi
- (c) Mumbai
- (d) Kota

4. The decay characteristic of positrons is exploited in which of the following imaging techniques:

- (a) NMR
- (b) RIA
- (c) PET-CT
- (d) MET

5. Which among these used in unsealed internal radio-therapy:

- (a) Caesium
- (b) Iridium
- (c) Palladium
- (d) All of These

6. Cobalt-60, a radioisotope, emits mainly:

- (a) X-rays
- (b) Gamma-rays
- (c) LASER
- (d) Beta-rays

7. When radio-isotopes are used as medicine, this branch is called:

- (a) Radio-immuno assay-RIA
- (b) Radiopharmaceuticals
- (c) Nuclear treatment
- (d) None of these

8. Strontium-90 is mainly responsible for:

- (a) Leukaemia
- (b) Skin cancer
- (c) Lung Cancer
- (d) Mouth Cancer

9. Which of the following is helpful in protection of humans from Ionising Radiation?

- (a) Beta-carotene
- (b) Omega fatty acid
- (c) Glutathione
- (d) All of these

10. Potassium Iodide and Prussian blue are widely recommended for removal of which of the following radio-isotopes during accident or atomic explosion?

- (a) Strontium-90
- (b) Cesium-137
- (c) Iodine-131
- (d) Tritium

11. Which is not an antioxidant?

- (a) Ascorbic Acid
- (b) Lycopene
- (c) Sodium Alginate
- (d) Rock Salt

12. Use of Nuclear Medicine in treatment is regulated by:

- (a) Bhabha Atomic Research Centre-Mumbai
- (b) Board of Research on Radio-isotope Technology-Mumbai
- (c) Atomic Energy Regulatory Authority-Mumbai
- (d) None of the above

13. The Civil Liability for Nuclear Damage Act was passed on:

- (a) 21st September, 2010
- (b) 12th August, 2004
- (c) 15th September, 1962
- (d) 26th April, 1984

14. World Cancer Day is celebrated every year on:

- (a) 2 February
- (b) 4 February
- (c) 31 May
- (d) 16 September

15. Which organisation belongs to the United Nations?

- (a) WANO
- (b) IARP
- (c) NPCIL
- (d) IAEA

16. Radioprotectants work on the principle of

- (a) Prevent DNA Damage
- (b) Antioxidation of biomolecules
- (c) Mutations & free radical scavenging
- (d) All of these

17. Mobile phones are sources of type of radiation.

- (a) Ionising
- (b) Non-ionising
- (c) Cosmic
- (d) None of these

ANSWERS: 1) a 2) a 3) b 4) c 5) d 6) b 7) b
8) a 9) d 10) b 11) d 12) c 13) a 14) b 15) d
16) d 17) b

Contributed by Devi D. Pandey, Department of Environmental Science, Guru Jambheshwar University of Science & Technology, Hisar-125001, Haryana



Funny Names from the Wild

MAYANGLAMBAM OJIT KUMAR SINGH

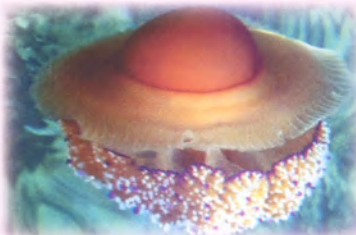
1. What common name is given to this Box jellyfish (*Chironex fleckeri*) which is considered to be "the most lethal jellyfish in the world"? The box jellyfish's venom attacks the heart, nervous system, and skin cells. Its venom is so overpoweringly painful, human victims have been known to go into shock and drown or die of heart failure even before reaching the shore.

- a) Sea wasp
- b) Suckerpunch of the sea
- c) Marine stingers
- d) All are correct



2. Fried egg jellyfish is the name given to a species of _____. It is a very large jellyfish, with a bell up to 60 cm (2 ft) in diameter and sixteen clusters of up to a few dozen tentacles, each up to 6 metres (20 ft) long.

- a) Cnidarian
- b) Water bug
- c) Fish
- d) Octopus



3. What other name is given to this animal called *Euplectella aspergillum*? This animal is found living in marine water of the sea or ocean. In a dead, dry state it is given as a wedding gift because the sponge symbiotically houses two small shrimps, a male and a female, who live out their lives inside the sponge.

- a) The Mar's Flower basket
- b) The Venus' Flower basket
- c) The Earth's flower basket
- d) The Jupiter Flower basket



4. These sedentary inhabitants of coral reefs in the picture belong to a class of annelid worms commonly called Bristle worms. By what name do we know these tube building animals which have chromatically hued spiral structures? The worm is aptly named because of the two chromatically hued spiral structures, the most common feature seen by divers.

- a) Christmas worms
- b) Christmas Bristle
- c) Christmas tree worms
- d) Sea tree worm



5. What alternate name is usually given to Octopus? Considered the most intelligent of all invertebrates, the octopus can grow to about 4.3 feet (1.3 meters) in length and weigh up to 22 pounds (10 kilograms).

- a) Monster fish
- b) Angler fish
- c) Spider fish
- d) Devil fish



6. These small, scavenging insects called Psocids with a relatively generalized body plan feed primarily on fungi, algae, lichen, and organic detritus. What common name is given to these insects which are found so common among the pages of old books in our libraries?

- a) Head lice
- b) Body Lice
- c) Book Scorpion
- d) Book Lice



7. What other name is given to this crab (*Birgus latro*), which is also the largest land-living arthropod in the world?

- a) Coconut crab
- b) Palm thief
- c) Robber crab
- d) All are correct



8. These rare uncommon insects also called the true leaf insects are some of the most remarkable leaf mimics in the entire animal kingdom. These leaf insects are also called:

- a) Jumping leaf insect
- b) Climbing leaf insect
- c) Walking leaf insect
- d) Flying leaf insect



FUNQUIZ

Name these insects (scientifically known as *Erotylidae*) which are usually found feeding on the fruits of fungi?

- a) Salty fungus beetle
- b) Sweet fungus beetle
- c) Mushroom beetle
- d) Pleasing fungus beetle



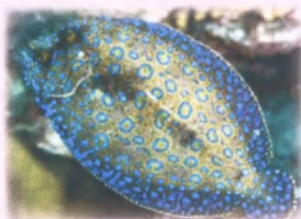
10. Starfish used to be the common name given to star-shaped echinoderms belonging to the class Asteroidea. This name has been replaced by:

- a) Brittle star
- b) Water star
- c) Fish star
- d) Sea star



11. *Bothus mancus* or the Peacock flounder is a species of fish which has both eyes on top of the left hand side of its head. It is also known as:

- a) The flowery flounder
- b) The fruity flounder
- c) The seedling flounder
- d) The leafy flounder



12. What common name is given to this unique horse-shaped fish (*Hippocampus*) species in which the males bear the unborn young? This fish has no teeth and no stomach. Food passes through their digestive systems so quickly, they must eat almost constantly to stay alive.

- a) Ocean horse
- b) Sea horse
- c) River horse
- d) Lake horse



13. This small chorus frog (*Pseudacris crucifer*) is to the amphibian world what American robin is to the bird world. What common name is assigned to these funny little champion singers who emit their familiar sleigh-bell-like chorus right around the beginning of spring?

- a) Spring singers
- b) Spring walkers
- c) Spring bringers
- d) Spring Peepers



14. Thorny Devil (*Moloch horridus*) belies its name because it moves slowly around the Australian desert, harming only the ant population which makes up its sole diet. What other name is given to this scaly-skinned lizard with prominent spines?

- a) Thorny dragon
- b) Mountain devil
- c) Thorny lizard
- d) All are correct



15. The peach-faced lovebird (*Agapornis roseicollis*) is a species of lovebird native to arid regions in southwestern Africa such as the Namib desert. The other common name given to this bird is:

- a) Rosy-faced lovebird
- b) Pink-faced lovebird
- c) Black winged lovebird
- d) Red-headed lovebird



16. What other name is given to the Indian flying fox (*Pteropus giganteus*)?

- a) The greater Indian bat
- b) The greater Indian fruit bat
- c) The greater Indian sky fox
- d) The greater Indian flying mammal



Answers:

1.d	2.a	3.b	4.c
5.d	6.d	7.d	8.c
9.d	10.d	11.a	12.b
13.d	14.d	15.a	16.b

Contributed by Dr. Mayanglambam Ojit Kumar Singh, Assistant Professor of Zoology, Ramjas College, Maurice Nagar, Delhi University, Delhi-110007
Figure of Q.1 and Q.13 are taken from <http://animals.nationalgeographic.com/animals/invertebrates/box-jellyfish/>. The other photographs are all from Google image.)

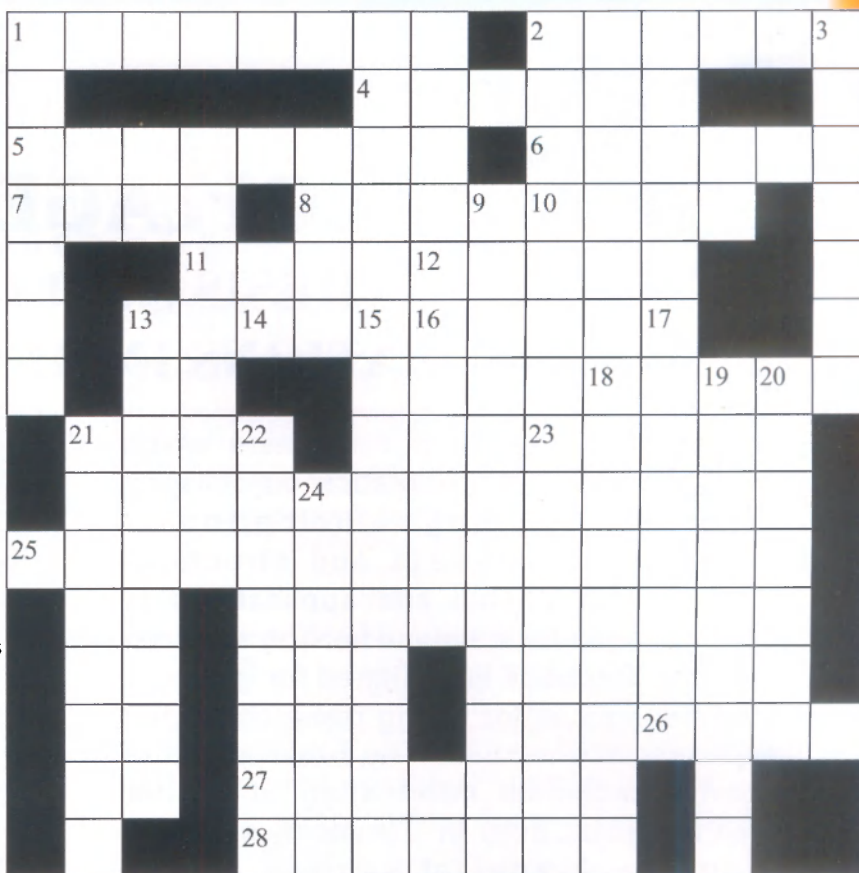
CROSSWORD

ACROSS

1. A heart-shaped curve, the equation of which is given by $(x^2 + y^2 - 2ax)^2 = 4a^2(x^2 + y^2)$ (8)
2. The constant π is the ratio of the circumference of a _____ to its diameter (6)
4. The equation of the _____ of Descartes is given by $x^3 + y^3 = 3axy$ (6)
5. The curve formed by a chain hanging freely between two points (8)
6. The equiangular _____ is inscribed on the tomb of Jakob Bernoulli (6)
7. A superellipse is also known as a _____ curve (4)
8. It resembles an egg (4)
10. The graphical representation of this trigonometric function is a wave-like curve (4)
11. An S-shaped curve (4)
12. Gauss regarded it as "the mathematical figure of the earth" (5)
14. A solid figure whose outer surfaces are triangles which converge to a point (7)
25. A _____ within a cylinder was surmounted on the tomb of Archimedes (6)
26. The circle, ellipse, parabola, or hyperbola are planar sections of a _____ (4)
27. A crook-shaped staff also known as the Bishop's crozier (6)
28. This curve is also known as tetracuspid, cubocycloid or paracycle (7)

DOWN

1. The curve named by Galileo is also known as "The Helen of Geometers" (7)
2. The ivy-shaped curve $y^2 = x^3 / (2a - x)$ was discovered by Diocles (7)
3. According to Kepler the orbit of a planet around the sun is an _____ (7)
9. Jacob Bernoulli called this curve which resembles 8 "a pendant ribbon" (7)
11. The earth has approximately the shape of an _____ spheroid (6)
13. This curve is shell-shaped which was used by ancients in buildings (7)
15. The rose-shaped curve $r = a \sin(k\theta)$ has one or more petals (8)
16. The curve Witch of _____ was called versivera by the lady discoverer (6)
17. The polar equation of the _____ of Pascal is $r = b + 2a \cos(\theta)$ (7)
18. The snail-form curve $r = a \sin \theta / \theta$ (9)
19. One of the conic sections the eccentricity of which is greater than unity (9)
20. A honeycomb cell has the shape of a _____ (7)
21. The kidney-shaped curve $x = a[3\cos(t) - \cos(3t)]$, $y = a[3\sin(t) - \sin(3t)]$ (8)



22. The path of a projectile in vacuum is a _____ (8)
23. This curve is also known as the cocked-hat curve (6)
24. In DNA the four nucleotides are arranged in a double _____ sequence (5)

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Solution August 2015 Crossword

